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ABSTRACT

The final report describes the Trine Project which addressed three needs in the education of handicapped children: the need for an alternate writing system, the need for communication, and the need for access to general purpose computers used in the schools. The project had three major objectives: (1) to design a low-cost portable writing and computer access aid using existing technology, (2) to provide alternative communication integrated with writing and computer access; and (3) to provide a tutorial manual that allows naive users to learn the system. The project resulted in a special computer program which turns the Epson HX-20 general purpose computer into a dedicated writing, conversation, and computer access aid with a structured tutorial manual. Results of field testing with 13 users and 6 consultants indicated that the Trine System can be learned effectively from the guidebook and that it can meet basic communication and writing needs of persons in educational settings. A nonexclusive marketing plan (in which a limited number of organizations have the right to produce and sell the system) was used and the Trine System is now available through two commercial companies. Among appendixes are product brochures, a conference paper on the design and testing of a tutorial manual, several questionnaires on system use and evaluation, and a manual critique. (Author/DB)

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THE TRINE PROJECT FINAL REPORT

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The Trine Project
Final Report

May, 1986

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The Trine Project -- Originally Named the Electronic Writing, Conversation, and Computer Access Aid Project -- Was Done Under Contract 300-83-0267
With the Office of Special Education
U. S. Department of Education

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1. ABSTRACT:

The electronic writing, conversation, and computer access aid project -- renamed the Trine project -- resulted from contract number 300-83-0267 with the U. S. Dept. of Education, Office of Special Education Programs. The Technology compensatory Activities RFP required the contractor to provide "a technology based aid to education which solves or minimizes a significant problem encountered in education of a handicapped child."[1] The RFP also specified that "the contractor will develop no component which contributes more then 10 percent to the total cost of the device . . ."[1] Finally, the RFP emphasized the importance of marketing the aid system by requiring a marketing plan and the involvement of potential manufacturers in the development process.

The Trine project addressed three significant needs in the education of children with disabilities, the need for an alternate writing system, the need for communication, and the need for access to general purpose computers used in the schools. It had three primary objectives: 1) to design a low-cost portable writing and computer access aid using existing technology, 2) to provide alternative communication integrated with writing and computer access, and 3) to provide a tutorial manual that allows naive users to learn to use and apply the system. There are three basic parts of the completed Trine System: 1)the Epson HX-20 notebook computer, 2) a special Trine computer program contained in computer memory "chips" called EPROMS, and 3) a tutorial guidebook call A Journeyer's Guide to the Trine System.

The Epson HX-20 notebook computer is a general purpose mass marketed, battery powered, four and three quarters pound, laptop computer. The special Trine computer program, permanently stored in five computer memory chips, turns the Epson HX-20 general purpose computer into a dedicated writing, conversation, and computer access aid. The guidebook is a 327 page structured tutorial using positive multimode presentations and produced effectively in very low volume using desktop publishing techniques.

The Trine System was placed with 13 users and 6 consultants for field testing. Information about use of the guidebook and Trine System was collected over a 2 month period. Results indicated that the Trine System can be learned effectively from the guidebook and that it can meet the basic communication and writing needs of persons in educational settings.

Three marketing plans were considered: 1) open distribution, 2) exclusive distribution, and 3) nonexclusive distribution. The open distribution plan provides the software at cost and allows anyone to copy the program and give it to someone else. The exclusive distribution model would give a single organization the exclusive rights to the system. A nonexclusive plan would give a limited number of organizations the right to produce and sell the system.

The nonexclusive plan was used in the actual transfer of the Trine System to commercial companies. The Trine System is now being marketed through two companies, Adaptive Communication Systems, Inc. in Coraopolis, PA, and Words+, Inc. in Sunnyvale, CA. It became commercially available from Words+, Inc. in December, 1985 and from Adaptive Communication Systems, Inc. in March, 1986. The Trine contract produced software and guidebook cost about $400 of the $2495 cost of the complete system. This is 16% of total cost. As of April, 1986 Words+, Inc. has sold 8 complete Trine Systems to people in 6 different states and Adaptive Communication Systems, Inc. has sold 10 complete Trine Systems.

2. Requirements, Targeted Needs, and Goals of the Trine Project:

2.1 **Requirements of the RFP That Initiated the Trine Project:** The electronic writing, conversation, and computer access aid project was the result of contract number 300-83-0267 with the U. S. Dept. of Education, Office of Special Education Programs. This project was subsequently renamed the Trine project.

Contract 300-83-0267 was the result of a proposal submitted by the University of Wisconsin-Madison Trace Center in response to an RFP titled Technology Compensatory Activities number 83-083. The Technology Compensatory Activities RFP had three main requirements. First, RFP 83-083, required the contractor to "create a technology based aid to education which solves or minimizes a significant problem encountered in education of a handicapped child."[1] Second, RFP 83-083 specified that "the contractor will develop no component which contributes more then 10 percent to the total cost of the device . . ."[1] Third, the RFP 83-083 emphasized the importance of marketing the aid system by requiring a marketing plan and the involvement of potential manufacturers in the development process.

RFP 83-083 required the contractor to identify those situations where a major educational barrier was almost being addressed with existing technology, except that minor but crucial pieces were missing. The contractor was to create a "technology based aid"[1] that met the need identified. RFP 83-083 defined technology based as "a domain which includes microcomputer, electronics, optics, television, laser, holography, and other recent developments of the kind which may be contributory to developing electronic prosthetics for the handicapped."[1] It envisioned that contractors would create the compensatory aids by "assembling, packaging, and customizing electronic components now marketed to support the microcomputer industry"[1]. RFP 83-083 was designed to provide the funding necessary to bring those existing components together into "marketable, affordable, portable, and useful devices for the targeted learners."[1]

RFP 83-083 also required that "the contractor will develop no component which contributes more then 10 percent to the total cost of the device . . ."[1] Furthermore, the entire specification, development, and testing period was to take no more than eighteen months to complete. Rather than looking for research or development efforts, the RFP 83-083 sought to support efforts which integrated and collated existing concepts and components into a compensatory aid that could be marketed immediately.

In addition, RFP 83-083 required that "The contractor shall provide a marketing plan as part of the final report of this contract."[1] It further required that "The contractor shall demonstrate the aid to typical potential suppliers of production models of the aid."[1] These and other requirements emphasized the importance of creating an immediately marketable compensatory aid and providing a way to immediately transfer it to a manufacturer for distribution.

2.2 **Needs Identified by the Trine Project:** The Trine project identified and addressed three significant needs in the education of children with disabilities: 1) the need for an alternate writing system for children physically unable to write, 2) the need for communication for children unable to speak, and 3) the need for children unable to operate an ordinary computer keyboard to access the computers used in school for regular activities .

Writing Needs: Probably the single most overlooked educational need of children with physical disabilities is the need for an effective mechanism for writing. No one would consider sending an ordinary child through fourteen years of school without a pencil and paper or any other means for

writing. It is doubtful that such a child would receive anything like an adequate education or be able to integrate the lessons presented if he or she did not do the written exercises, homework, or independent work as part of the educational program. It is difficult to imagine learning to organize one's thoughts without ever writing down or manipulating those thoughts on paper. Such a child would be left in the position of passively observing the educational process without being able to carry out the activities necessary to assimilate the information being presented.

A large number of children with physical disabilities are unable to use a standard pencil and paper. If these children are to be able to have any chance of really benefiting from their educational program, it is essential that they be provided with some type of "pencil and paper" equivalent. Further, this alternate pencil and paper must be able to go along with the child and fulfill the same functions as the normal pencil and does for the ordinary person. This includes the ability to take notes, do independent work both in school and at home, carry out mathematical manipulations, organize thoughts, complete assignments, etc.

A standard electric typewriter cannot meet these needs. An ordinary child would find it difficult or impossible to throw away a pencil and paper and survive solely on an electric typewriter. The physical and mental manipulations required to take notes, carry out mathematical operations, and do regular schoolwork, would be extremely difficult and frustrating. Nor could a single typewriter or writing system shared by a number of children with disabilities meet the writing needs of these children, any more than a pencil or two shared among a class of ordinary children would meet their writing needs.

Thus, in order to provide a child with physical disabilities with a reasonable chance for education or employment, it is essential that he or she be provided with an alternate pencil and paper, a personal means for writing. This alternate pencil and paper must be portable and unobtrusive so that it can be kept with the child while she or he moves within the school, work, and home environments. It is also important that these alternate "pencils" be provided to the child at the same time that the ordinary child is provided with pencil and paper. Finally, it is important that the alternate pencil and paper allow the child to write at something which approaches the writing rate of the ordinary child. A child who writes five to ten times slower than ordinary students will be unable to keep up with regular work. One day's work every week or two is unacceptable in education or employment. Thus, it is very important that the alternate pencil and paper be as fast as possible.

Communication Needs: Although not the direct focus of this project, a subset of the population of children who are physically unable to write are children who are also unable to communicate vocally. Any electronic aid for writing can also be used as a means for "vocal" communication. By attaching a commercially available voice synthesizer to the writing system and providing the proper driver routines, it is possible to use the writing system as a portable conversation aid as well. As a result, the provision of a good writing and computer access system can also greatly facilitate the communication and interaction problems faced by those people who are otherwise unable to communicate vocally. In fact, if carefully implemented, such a system can equal or surpass the effectiveness of many of the conversation only aids. However, it should be noted that this type of system would not be superior to the existing non-vocal communication aids for all people.

Computer Access Needs: Accessing a general purpose computer is a need which may not be obvious for those of us who came through an educational system without computers and whose work places are untouched or barely touched by computers today. However, the use of computers in both education and employment is increasing at a rapid rate, and it is doubtful that many children will be able to make it through school if they are unable to access or use computers.

The key is to provide a way for a child who is unable to operate the ordinary keyboard to operate the general purpose computer running regular programs written for ordinary users. It is not sufficient to find one or several computer programs which can be operated by a person with severe physical

disabilities. First, only a small fraction of the types of regular programs available are also available with the modifications necessary to make them usable by people with physical disabilities. Second, as computers and computer programs become a part of the regular education curricula, it will be essential that children with physical disabilities by able to use the same educational programs as their classmates in order for them to participate normally. For children with physical disabilities to be limited to specially modified programs would be similar to trying to have a few ordinary children out of a regular class use a textbook that is completely different from (and usually greatly inferior to) that used by the other members of the class.

Thus, children with physical disabilities who are unable to use the ordinary keyboard (such as two handed operations like typing a shift key in conjunction with another key) need to be provided with some other access system. This system must allow them to operate the same computers used by the ordinary children in the classroom. It must work with all the regular software programs without requiring modifications.

2.3 Goals of the Trine Project:

The Trine project had three primary objectives. The goals of the Trine project were:

1) To develop and make available a low cost, portable, writing and computer access aid using existing technology

2) To integrate the writing function, the computer access function, and the communication function

3) To develop and make available a tutorial manual for the aid system that allows naive users to learn and use the system effectively without expert help.

The Trace Center's goal was to develop a writing, computer access, and communication aid to meet the needs identified above. At the time the Trine project was conceived there were no systems that adequately met these needs. The need for portability was seen as especially important since many of the children with writing disabilities are ambulatory and need to carry their alternate writing aid from class to class. The recent development of very powerful, very portable, and relatively inexpensive general purpose computers made such an aid system practical for the first time. The affordability of these new computers was a significant factor since many parents, school systems, and other support agencies have great difficulty finding the funds necessary to provide aid systems to children with disabilities. Thus, two major goals of the Trine project were to develop a system that was as affordable and as portable as possible.

Another major goal set by the Trace Center for the Trine project was to integrate the three functions, writing, computer access, and communication into a single aid. Since a child needs to interrupt writing work to answer questions, and needs to interrupt computer access work to answer questions the Trace Center felt that it was very important to design the Trine System so that all three function were always available and to make it possible to suspend one kind of activity without loosing work while doing something else.

A third major goal of the Trine project was to develop a tutorial manual for the aid system that allows naive users to learn and use the system effectively. Other technical aid systems have been observed to be underutilized because users are unable to learn from the documentation provided and are unable to get the expert help they need locally. Many users can't get expert help locally because they are in less populated areas and the manufacturer who has no local expert. The Trace Center felt that by providing a very effective manual that many of these problems could be mitigated and the aid system would help more people more effectively.

3. Description of the Products of the Trine Project:

3.1 **General Description of the Completed Trine System:** There are three basic parts of the completed Trine System, the Epson HX-20 notebook computer, a special Trine computer program permanently stored in five computer memory chips, and a tutorial guidebook called A Journeyer's Guide to the Trine System.

The Epson HX-20 notebook computer is a general purpose, mass marketed, battery powered, portable computer. It was chosen because it has a good keyboard, a functional screen, a built-in printer, a built-in microcassette for storing information, and it is relatively inexpensive.

The special Trine computer program turns the Epson HX-20 general purpose computer into a dedicated writing, conversation, and computer access aid. The program was developed as part of this contract by the Trace Center. The Trine System program is stored on computer memory chips that are plugged into sockets inside the Epson Computer.

The tutorial guidebook is the third major component of the Trine System. It was designed and written in conjunction with the Trine computer program in order to assure that the Trine System was as easy to learn and use as possible. The guidebook is designed to make it possible for a person with average intelligence and no computer experience to learn the Trine System without the help from an expert teacher.

3.2 **Description of the Completed Trine Hardware System:** The heart of the Trine System is the Epson HX-20 notebook computer. This is a four and three quarters pound 8.5" x 14.5" x 1.75" battery powered, portable, laptop computer. It is mass marketed by Epson America, Inc. for about $800.

The Epson HX-20 has a built-in full sized 68 key keyboard, a built-in 4 line by 20 character display, a built-in 24 column printer, and a built-in 50k cassette tape storage unit. It also has a built-in RS-232-C serial port that can be connected to an external printer, an external speech synthesizer, or a keyboard emulating interface for accessing a general purpose computer running regular software.

The Trine System assigns special functions to 26 of the 68 keys on the Epson HX-20 keyboard. Special key labels for these 26 keys make the functions easier to use. A special Trine System quick reference chart also fits on the Epson HX-20 expansion unit. This chart shows the key combinations that produce 29 of the Trine System functions. Special moisture guards are available to protect the keyboard from dirt and saliva.

The Trine System program is designed to work with three main speech synthesizers. It works with the Adaptive Communication Systems, Inc. SpeechPac which is a speech synthesizer built into the standard Epson HX-20 expansion unit. The Trine System software also works with RS-232-C speech synthesizers like the Portable Voice from Words+, Inc. and the Dectalk from Digital Equipment Co. Both the SpeechPac and the Portable Voice make the Trine System a portable speech output aid system.

The Trine System is designed to access general purpose computers running regular software through standard keyboard emulating interfaces. These interfaces connect to the Trine System through the Epson computer's RS-232-C port. There are standard cables available from Epson to make this connection.

3.3 **Description of the Completed Trine Software System:** The Trine System software is a sophisticated program written in the Forth language for compactness and speed. The 40k of object code is stored permanently on 5 EPROM computer memory chips for reliability, ease of use, and marketability. This approach also frees up the computer's regular memory making more available to

store the user's work. The software makes use of all the resources of the Epson HX-20, including the built-in printer, screen, tape drive, and serial port.

The Trine System software is designed to be easy to use by beginners while providing flexibility for more advanced users. It uses menus and dedicated keys for most functions. It has 143 different menus and there are about 33 functions on dedicated keys including 22 editing functions.

Four of the keys are tri-stated to make it possible to type one key at a time and still create shifted keystrokes. This makes one finger typing practical. Pushing the [SHIFT] key, the [ALT] key, the [CTRL] key, and the [QKY] key once causes them to be automatically held down while the next key is typed. By pushing them twice in a row they can be locked on. Pushing them one more time releases them.

The Trine System offers six different writing workspaces, a conversation workspace, and a keyboard emulating interface workspace. These are always active and retain any work even when the computer is turned off. The workspaces have full screen editing with a complete set of editing functions including copying blocks of text. In a fourth area called the toolbox users can easily add or change abbreviations. Users can move into another workspace instantly at any time by pressing a single key without disturbing anything in the current workspace.

Each of the six writing workspaces holds 55 lines of text 20 characters long. Material written into these workspaces is retained even when the Epson is turned off. The different writing workspaces allow children to organize there work. They can do things like keeping notes from different classes together. They can also move freely between these workspaces by pressing a single key. The workspaces can also be linked together for longer documents.

The Trine System has a two mode abbreviation expansion system called QuicKey. This versatile system can be set up to implement all known abbreviation/expansion schemes. QuicKey can store about 400 twelve character user programmable expansions. With QuicKey any characters can be used in the abbreviation and the expansion. The expansion can have as many as 256 characters.

The Epson HX-20's built in cassette drive is programmed to store the user's abbreviations as well as up to 18 workspaces of writing. The writing workspaces can be saved onto microcassette tapes that are organized into three different volumes on each tape. Each page and volume can be given a name by the user to help them find their work. By using different tapes the user can store an unlimited amount of material.

The Trine System software works with the built-in printer or an external printer. It can work with an internal or an external speech synthesizer. The program allows the user to change settings like the margins on the external printer and pitch on the speech synthesizer.

Almost all program parameters are user settable. There is an area in the Toolbox called the Adjustor which contain menus for changing settings to suite a particular user. In addition, the Trine System "goes to sleep" to conserve power if nothing is done for more than 10 minutes. Pushing the [WAKEUP] key returns the Trine System to the active state.

3.4 **Description of the Completed Trine Tutorial Manual System:** The Trine System tutorial guidebook, A Journeyer's Guide to the Trine System, is a tutorial manual included with the Trine System. The primary goal of the guidebook was to create a printed document as physically accessible as possible that would allow a disabled user with normal intelligence, a sixth grade reading level, and no computer or multifunction aid experience to learn the Trine System without expert help. Secondarily, the guidebook was designed for small manufacturers to easily produce, maintain, and update in printing runs of as few as 50 copies. To accomplish these goals three major approaches were incorporated into the design: 1) structured documentation; 2) positive multimode presentations;

and 3) desktop publishing. We have included a copy of the A Journeyer's Guide to the Trine System with this report.

The Trine System guidebook is an 8" x 9" three ring binder with about 325 pages and 120 illustrations. There are six color coded major sections and 22 regular sections. The 22 regular sections each have a matching colored tab. Important sections include a Table of Contents, a Learning Tips section, a Troubleshooting section, a User Tips section, a Glossary, and an Index. The page masters were designed and printed using desktop publishing techniques. The books were printed using ordinary photo copiers.

The first major approach used in the creation of the Trine System guidebook is called structured documentation. Structured documentation evolved from the intense documentation and training requirements for computer software in companies like IBM, Wang, and Digital Equipment Co. Its overriding goal is to make it possible to design, produce, and maintain effective documentation in the most cost effective and time effective way. Structured documentation can be done successfully by any size company. Structured documentation is:

1) modular
2) structured in a top-down fashion
3) written using clear communication techniques

The second major approach used in the creation of the Trine System guidebook was to design, write, typeset, print and assemble the guidebook in-house using a graphics based microcomputer system. This has since come to be called desktop publishing. Because most small aid system companies print 100 or fewer manuals at a time, the cost to produce quality tutorial manuals using traditional publishers and bookmaking techniques is prohibitive. Desktop publishing offers the possibility of making and upgrading quality manuals in small quantities. The overall design and layout of the guidebook was strongly determined by technical limitations of the computer system used.

The third major approach, using a positive multimode presentation of key information, incorporates new ideas about different cognitive learning styles to make the book more effective for different people. To communicate effectively to a wide variety of people, the guidebook presents the same information in a variety of ways. In addition, information was always presented positively in the logical sense. Negations were actively eliminated. For example, rather than writing, "The power switch doesn't have to be turned off," we would write "You can leave the power switch on."

In the Trine guidebook the same topic was presented in up to five different ways. Providing the different presentations is relatively cheap when implemented with desk top publishing equipment. The different presentations were:

1) a summary
2) straight text
3) a follow along example
4) a realistic illustration of the device in use including a facsimile of the computer screen
5) a tabular instruction list.

It was found from interviews with the users and their families, teachers, and clinicians that each of the five types of presentation was the primary information source for different people. The 15 people interviewed were almost evenly split for their primary information source between all five types of presentation. From these interviews the Trace Center believes that the positive multimode approach was important to the effectiveness of the guidebook.

3.5 **Description of the Completed Trine beta test:** The initial version of the both the Trine System software and the Trine guidebook were field tested with typical users. The Trine System was placed with 13 users and 6 consultants. Information on how people were using it was collected over a two month period. The goal of the beta test was to determine how well people learned the system from the guidebook and how well the Trine System met their basic writing, computer access, and communication needs in educational, vocational, and daily living situations.

On procedure of the beta test was designed to see if users and their support groups could learn the basics of the Trine System from the Trine guidebook without help from experts. If this could be shown then it would be likely that the cost to place and support the Trine System would be lower than for systems that require personal training by experts.

Six users and their supporting families, teachers, and clinicians were given the Trine System and the Trine guidebook. They were told to learn the system on their own. The Trace Center gave them no direct support. After two weeks each of the six groups was brought in and the users were evaluated on the basic use of the Trine System. They were also interviewed on how they had used the Trine Guidebook and what they liked and didn't like about the Trine System and Trine guidebook.

With regard to the effectiveness of the guidebook the beta test concluded that it allowed users to learn the Trine System without expert support. The following is an excerpt from the Beta Test Report:

> "After two weeks of using the Trine System without any direct training by the Trace Center, subjects in Level 1 were asked to demonstrate basic functions of the aid. Five out of six of the subjects were able to get into different workspaces, delete characters, lines, and pages, move the cursor in all directions, insert words and print on the built-in printer. In the case of the one subject who was not able to perform all these functions the father was able to demonstrate them. The skill demonstrated by either the subjects themselves or their primary trainers suggest that it is possible to learn the basic operation of the Trine System using the training manual in conjunction with hands on exploration without external support or training. All subjects in Levels 1 and 2 agreed that they were provided with sufficient information to learn the basic functions of the Trine System and did not require any direct training. In addition, three subjects had incorporated the system into their classes or daily environment within two weeks."[2]

The beta test report also concluded "that the Trine System can meet the basic communication and writing needs of a person in educational, vocational, and daily living situations."

> "The three most satisfied subjects were all students - two in elementary school and one in high school. For these subjects, the system was quickly incorporated into their daily environment and they relied heavily upon the Trine to fulfill their daily writing needs. An aid that can meet multiple writing assignments and move easily between classes is a prime candidate for an educational environment. On subject in 5th grade was so excited with the new system that he commented "college is gonna be a breeze!"[2]

For the complete beta test results see the Beta Test Report, attachment 6.1.

3.6 **Trine Project Spinoff:** The Trine project developed new techniques, approaches, and information that can advance the communication aid field as a whole. The three highly integrated functions, writing, computer access, and communication, the emphasis on portability, as well as the new and powerful abbreviation expansion system distinguish the Trine System from other aid systems. These have been written about and discussed at several national conferences in the last two and a half years.

The special emphasis on beta testing and the development of an effective tutorial manual were also new to the communication aids field. The Trace Center made efforts to make key manufacturers and developers aware of this work. At a September 1985 workshop attended by almost all the major communication aid system developers and manufacturers in North America, the Trace Center presented results of the guidebook beta test and encouraged developers to consider the Trine guidebook as a possible model to use for their own tutorial documentation . The results of the beta test of the Trine guidebook are also described in a paper titled *The Design and Testing of a Tutorial Manual That Allowed Users To Learn a Multifunction Aid System Without Expert Support* to be presented at the Ninth Annual Conference on Rehabilitation Engineering in Minneapolis, MN, June 21-26. A copy of this paper is included as attachment 6.4.

The techniques used to develop and produce the Trine guidebook can be used for other tutorial manuals and some of these techniques have already been adopted by communication aid companies in addition to the two that were directly involved in marketing the Trine System. The Trace Center has provided copies of the Trine guidebook and a summary of the techniques used to develop it to eight of the major communication aid system developers and manufacturers in North America. Prentke Romich Company, the largest communication aid system manufacturer in the United States and one of the reviewers of the Trine System and the Trine guidebook, has recently made the development of tutorial manuals a key part of its new product development process. It is also incorporating the structured documentation approach demonstrated in the Trine guidebook and has already incorporated several other features of the Trine guidebook in its new LIGHT TALKER aid manual. As part of this spinoff process Prentke Romich Company asked the Trace Center to critique this manual and a copy of the critique provided to the company is included as attachment 6.5.

The Trine project has also focused the communication aid field's attention on the need for electronic writing aids. In the Trine beta test the Trace Center identified a population of children who need a writing aid system and a computer access aid system but who don't need an interactive communication aid because they can already speak adequately. This need has been largely overlooked by communication aid companies. Up to now these companies have focused mainly on people who primarily need interactive communication. As a result of the Trine project both Words+, Inc and Adaptive Communication Systems, Inc. have sold portable writing and computer access aid systems without speech output and this is now a market they intend to address. In addition, another major communication aid company ZYGO Industries, Inc. which reviewed the Trine System and guidebook has recently released its first portable writing only aid system called the Zygo Notebook.

4. MARKETING THE TRINE SYSTEM:

4.1 **The Three Marketing Approaches Considered:** The Trace Center considered three different marketing approaches for the Trine System. The primary goals were to maximize the availability of the Trine System and to maximize the likelihood that a user would get the support necessary to effectively use the system. The three types of marketing strategies considered were:

1) open distribution
2) exclusive distribution
3) nonexclusive distribution.

Open Distribution: In the open distribution approach the distributor sells the software at cost and allows anyone to copy the program and give it to someone else. The cost will include some consultation costs to support answering questions about how to use the software. Only people who purchased software from the distributor could get their questions answered. People who get a copy of the program would have to depend on the person they copied it from to support the software. The Trace Center believes that most of the people copying and redistributing the software will probably

be clinicians, who after they learn the answer to particular questions, will not need to contact the original distributor.

This method provides very low cost but is limited in its ability to make the system widely know. It depends primarily on professional journals (one-time only) for describing the software and word of mouth for advertising.

Another major problem with this approach is that people who prescribe aids tend only to purchase systems they have seen. With open distribution there would be no formal or defined method for this type of demonstration. As a result many people may not prescribe the Trine System even if they have heard about it, because they have not seen it in operation.

The open distribution method is only viable if clinicians /parents become familiar with computers or have access to someone who is. In addition, the manuals or the the self documentation in the program on the operation of the aid must be clear enough for a naive user to understand it. Even if the documentation were good, the Trace Center feels it is unlikely that clinicians unfamiliar with computers would feel comfortable getting the computer and the program separately.

Exclusive Distribution: The exclusive distribution approach would give a single organization the exclusive rights to the software. The primary advantage is that the organization would be willing to invest in marketing the product because that investment would pay back exclusively to itself. Another major advantage is that the distributing organization is likely to provide a completely integrated system with installed programs, all the necessary hardware, and documentation.

This investment in marketing would make it more likely that clinicians and potential users could get demonstrations of the system from people trained in its use. The demonstration would serve as a means to show the clinicians how to use the System and inform them on the application which Trine System can be used.

Exclusive distribution would provide more advertising than open distribution but that would also increase the price of the system. The system would also be dependent on only one distributor and this distributor may not be able to easily support a wide geographical area. This type of agreement may also restrict the availability of the source code for modification or replication on other machines and thus slow the potential improvements possible with newer more powerful computers.

Nonexclusive Distribution: A nonexclusive approach for distribution would give a nonexclusive distribution license to any organization or person who could demonstrate the ability to supply complete systems and support for the software. The license would allow the distributor to sell and modify the software without any royalty fees. There would be a license fee that would cover consultation/training time with the Trace Center. Copies of the source code would also be provided to allow the licensees to modify and sell their own versions. The licensees would set up their own prices and support systems.

With this approach clinics could be licensed distributors of the aid system. This would allow clinics who prescribe electronic aids and understand the operation of the aid to distribute the aid to their own clients at lower cost. These clinics would not have to support advertising or middlemen costs.

The primary disadvantage of this system is that the larger established manufacturers are less likely to become involved. They might feel that an already small market divided up between several supplying organizations would be too small to produce any return on the investment required to support another product. They might also feel that their more extensive advertising and dealer support would disproportionately aid their smaller competitors.

4.2 **Actual Commercial Transfer Process:** A modified form of the nonexclusive marketing approach was used in the actual transfer of the Trine System to commercial companies. The Trace Center contacted major communication aid system manufacturers and asked them if they were interested in either exclusive marketing or nonexclusive marketing. One company said it might be interested in exclusive marketing and two companies said that they were interested in a nonexclusive marketing approach.

The Trace Center decided to market the Trine System through the two companies willing to use the nonexclusive approach. The companies were Adaptive Communication Systems, Inc. in Coraopolis, PA, and Words+, Inc. in Sunnyvale, CA. Rather than create a formal license agreement the Trace Center provided the software on EPROM microchips which are difficult to copy casually. Rather than charge a license fee to cover support costs the Trace Center has provided support for the two companies under its commercial facilitation project. Reasons for selecting this approach included:

1) Both companies were already producing aid systems that used the Epson HX-20 so it was felt that they would be well able to support the Trine System.

2) Both companies indicated a willingness to improve and add features to the Trine System.

3) Both companies sell nationally but one is centered in the East and the other is centered in the West so it was felt that the Trine System would get good exposure throughout the country.

4) Both companies already had portable speech synthesizers that could be used with the Trine System.

Both of these companies were involved early enough in the development process of the Trine System to provide criticism and suggestions. They agreed that the best way to effectively license the Trine System was to put the program permanently on computer memory chips that are relatively difficult to copy. This was done and then master chips were provided to the companies to produce the Trine Systems for sale.

The Trine System guidebook was another major part of the Trine System provided to the two manufacturers. The Trace Center needed to produce 50 copies of the guidebook to support the beta test users and to support the dissemination of ideas generated by the Trine project. ACS, Inc., and Words+, Inc. asked if they could pay the Trace Center to produce an additional 50 copies of the guidebook for each company. These copies are being used for the initial sales. The Trace Center agreed to do this because it would allow the Trine System to become commercially available about six months sooner. The Trace Center also found out that producing 150 guidebooks rather than 50 was cheaper per book for the materials and printing costs.

As part of the commercial transfer process ACS, Inc. and Words+, Inc. were each sent:

* A set of five master computer memory chips containing the program
* A master for the special Trine System key labels
* A master for the Trine System quick reference chart
* 50 copies of the Trine System guidebook
* A set of 327 paper masters for the guidebook
* A set of 10 computer disks containing the electronic masters for the guidebook.

4.3 **Present Commercial Status:** The Trine System became commercially available from Words+, Inc. in December, 1985 and from Adaptive Communication Systems, Inc. in March, 1986.

As of May, 1986 Words+, Inc. sells a complete system including Epson HX-20 and the Portable Voice speech synthesizer for $2495. There is a one year warranty. At this time Words+ has sold 8 complete Trine Systems to people in 6 different states. A copy of their initial Trine System product announcement is included as Attachment 6.2.

As of May, 1986 Adaptive Communication Systems, Inc. sells the Trine SpeechPac system for $2495. This system has a speech synthesizer built into the Epson expansion unit. There is a one year warranty. At this time Adaptive Communication Systems, Inc. has sold 10 complete Trine Systems. A copy of their initial Trine System product announcement is included as Attachment 6.3.

At this time both companies are just beginning marketing efforts and expect sales to increase. Each company has invested several thousand dollars in 100 guidebooks, 100 extra sets of tabs, and 200 sets of special key labels. The initial sales have been typical for successful communication aid systems.

According to the Words+, Inc. and Adaptive Communication Systems, Inc. the retail cost of the components of the Trine System provided by the Trace Center constitute about $400 of the $2495 price. This is 16% of the final cost of a Trine System and even though the manufacturers set their prices independently, based on current market conditions, this compares favorably with the original goal of 10%.

5. REFERENCES

1. Request for proposal, Technology Compensatory Activities, RFP Number 83-083, Fiscal Year 1983, U. S. Department of Education Assistant Management and Procurement Services, Washington, D.C. 20202.

2. Electronic Writing, Conversation and Computer Access Aid, Beta Test Report for DOE GRANT 300-83-0267, Technology Compensatory Activities, July 1985, Trace Research and Development Center on Communication, Control, and Computer Access for Handicapped Individuals, University of Wisconsin-Madison.

6. ATTACHMENTS:

6.1 **Beta Test Report:** Electronic Writing, Conversation and Computer Access Aid, Beta Test Report for DOE Grant 300-83-0267, July 1985.

6.2 **SpeechPac Trine System Product Brochure:** Adaptive Communication Systems, Inc., Box 12440T, Pittsburgh, PA

6.3 **Words+ Trine System Product Brochure:** Words+, Inc., 1125 Stewart Court, Suite D, Sunnyvale, CA

6.4 **A Conference Paper:** Rodgers, Barry L., *The Design and Testing of a Tutorial Manual That Allowed Users To Learn a Multifunction Aid System Without Expert Support*, Proceedings of the Ninth Annual Conference on Rehabilitation Engineering, Minneapolis, MN, June 21-26, 1986.

6.5 **A Manual Critique as an Example of Trine Project Spinoff:** A memo giving a critique (at Prentke Romich's request) of a new Prentke Romich Company users manual that used features from the Trine guidebook.

ELECTRONIC WRITING, CONVERSATION AND COMPUTER ACCESS AID

(EWCCAA)

Beta Test Report for DOE Grant 300-83-0267

Technology Compensatory Activities

July

1985

Trace Research and Development Center
On Communication, Control and Computer Access
For Handicapped Individuals

University of Wisconsin-Madison

INTRODUCTION

I. Overview of the Trine System Aid

The Electronic Writing, Conversation and Computer Access Aid (EWCCAA) is a communication device developed on the Epson HX-20 portable computer for people with severe motor control disorders affecting their ability to speak, write, or access standard keyboards. This includes persons with cerebral palsy, paralysis, weakness due to muscle diseases, or other physical disabilities. A user of this aid must be able to or have the future potential to spell.

The aid has been renamed the Trine System to emphasize the three primary functions: conversation, writing, and access to standard computer systems. A built-in or external speech synthesizer can provide voiced output for "talking". Single words and phrases can be retrieved in order to increase the communication rate by reducing the time needed for spelling. The LCD display and printer provides an "electronic" piece of paper for the user to see text as it is entered. Special software increases the efficiency of completing and organizing written work. The worksheet provides an individual with a "pencil and paper" for entering and editing text. The notebook function allows an individual to store and retrieve the worksheet pages in an organized fashion on the cassette tape. The notebook is similar in concept to a folder used to hold papers for different topics and subject areas. The last function of the aid is access to other computer systems. Keyboard emulating software provides an interface to other computer systems. This allows an individual to operate any standard computer that has an RS-232 standardized keyboard emulator and run commercial software using the Trine System.

There are three main parts of the Trine software: input interface, acceleration routine and output functions.

The input interface allows the user to control the aid using his/her most optimal physical capabilities. The built-in keyboard on the Epson HX-20 portable computer has been modified so that it functions as a single finger keyboard. This eliminates the need for two keys to be held down simultaneously, which is often required with standard keyboards to generate shifted and control characters. The single finger keyboard only requires the user to first touch the modifying key (control, shift, alt) and then the standard key (A-Z, 0-9) to generate such characters. The Trine software was designed so that other input interfaces such as special external keyboards and Morse Code can be easily implemented by the distributors of the system.

Acceleration routines increase the effective selection rate of the user by decreasing the number of selections or keystrokes to communicate an idea or message. The acceleration technique used with the Trine System is "QuicKey" which generates abbreviation expansions. "QuicKey" converts a sequence of characters to another sequence of characters. For example, "dfn" can be assigned to represent the word "definition ". Every time "dfn" is entered in the autoexpansion mode, it will immediately be converted to "definition ". The number of keystrokes needed is reduced from 10 to 3. Each abbreviation and expansion is completely programmable by the user to meet his/her specific language needs and capabilities.

Several output functions will be available. Speech output can be provided by speech synthesizers. Other options will include a printer hookup, the notebook, the worksheet, and output to a second computer.

In summary, the Trine System provides individuals with physical disabilities a tool which allows them to take notes in classes, complete written work, perform math functions, and converse with voiced output at an accelerated rate. It also allows them access to other computer systems so that they can use standard software available to the general public. Most importantly, an individual is able to easily switch between these functions by operating the Trine System using his/her optimal input mode.

II. Statement of the Purpose

This final beta test report will review the objectives and procedures submitted in the original proposal and highlight the findings from the two month field test period. A discussion following the results will provide suggestions for using the Trine System, suggestions for improving the system, and suggestions for providing support for the system. A critique of the field test procedures will also be included.

The objectives of the Trine project as defined at the onset were the following: 1) to design a low-cost portable communication aid using existing technology, 2) to provide writing, conversation, and computer access in a single integrated aid, and 3) to provide documentation to allow naive users to assemble, use and apply the system. Careful testing of the Trine System was needed in order to determine its effectiveness in meeting these goals and to ensure its future effectiveness as an augmentative communication aid.

Field testing of the Trine System was the final phase of the project prior to marketing. The aid was placed with individuals in a variety of environments. These individuals, their families, teachers, therapists and professionals evaluated the system for its ability to achieve each of its goals and provided suggestions for future modifications. The overall objective of the beta testing was to answer the following question:

Will the Trine System help meet the basic communication and writing needs of a person in educational, vocational and daily living situations?

REVIEW OF METHODS

I. Subject Description

Information was collected from three major sources:

1. six children and adults using the Trine System within Wisconsin (Level 1)

2. seven clients located outside of Wisconsin working with independent research and clinical centers (Level 2)

3. six consultants from major research centers, clinics, and manufacturers
(Level 3)

Subjects in Levels 1 and 2 were placed with the Trine System for a two month trial period. Information was collected from the clients, families, and professionals working with the clients. The six subjects in Level 1 provided the most comprehensive information since they were located in close proximity to the Trace Center. The seven subjects in Level 2 provided more general, subjective feedback since they could not be observed directly. They also provided valuable information on the feasibility of mail order delivery. Level 3 consisted of six consultants who evaluated the Trine System for one week periods and provided feedback on the operation, human factors, and physical aspects of the aid. Included in this level were 4 manufacturers of augmentative communication aids.

All subjects in Levels 1 and 2 had access to an Epson HX-20 computer. 11 out of 13 subjects had previous experience with the computer and two subjects were unfamiliar with the computer. However, the individual(s) responsible for training the two naive users had previous experience with the computer.

Figure 1 provides information on each subject in Levels 1 and 2.

Weekly information was not collected from 5 of the 13 subjects. Three of the subjects' computers needed major repairs during the beta test period and were therefore unable to complete the full two months of testing. Two subjects mailed in their questionnaires only occasionally. However, as much feedback as possible was collected from each of these subjects. Ten subjects completed the final questionnaire even though not all had completed a full two months.

II. Data Collection

A. Levels 1 and 2

The following specific data collection procedures were used by Levels 1 and 2 to assess the documentation, system specifications, communication effectiveness/efficiency using this system, and overall satisfaction:

1. Special software routines embedded in the program tracked the overall usage of the aid by recording the frequency of utilization of each of the major functions of the system. This automatic data recording technique increased the reliability of the study and decreased the demands and expectations placed on the subjects and individuals in their environments. The total amount of time and the number of times used were recorded weekly for each of the following functions:

   a. Tracewriter
   b. Tracetalker
   c. Standard Keyboard Emulator
   d. General Serial

In addition, the number of times each abbreviation was used was recorded.

2. Questionnaires provided quantitative and qualitative information about the functioning and relative usefulness of the different capabilities of the aid. Subjects and individuals involved with the training process were asked to rate various features of the aid, record all problems encountered, and provide critical feedback. The following questionnaires are included in Appendices A through F:

a. prescreening questionnaire
b. preevaluation questionnaire
c. weekly checklist of functions
d. alternate week application performance questionnaire
e. weekly problem log
f. postevaluation questionnaire

3. Phone interviews were conducted weekly to determine the specific nature of problems recorded on the daily log and to allow subjects to provide feedback and suggestions about various features of the aid.

4. Direct observations of subjects in Level 1 were made during a 2-week and final evaluation in order to provide additional information on the actual use of the system.

Subjects in Level 1 were not given any direct training during the first two weeks of the field test. Upon installation of the Trine software, it was explained to the subjects that no support would be provided during the first two weeks in order to help evaluate the feasibility of mail order delivery.

At the end of the second week, subjects in Level 1 were tested at the Trace Center to determine the degree to which they were able to master the basic operation of the system independently. The evaluation included a discussion of problems encountered, initial impressions, a questionnaire designed to evaluate the manual, and a demonstration of use of the aid. The demonstration involved copying and editing a short paragraph and a timed comparison of copying sentences using abbreviation expansion and not using it.

Subjects in Level 1 returned to the Trace Center at the end of the two month period for a final evaluation. This evaluation followed the same format as the two-week evaluation.

B. Level 3

The consultants in Level 3 evaluated the Trine System for one week. A general feedback questionnaire and marketing questionnaire were completed. These are included in Appendices G and H.

III. Results of Beta Testing

The results that will be reported are based upon the information collected from the 13 subjects and 6 consultants. As discussed previously only eight subjects completed the full two month beta test period. Feedback provided by the other five subjects who participated to a lesser extent has been included when appropriate. Much of the information was collected through the final questionnaire. Ten subjects who had used the

Trine System for varying lengths of time completed and returned the questionnaire.

A. Feasibility of Mail Order Delivery

After the Trine System had been placed, subjects were asked to learn the system using the manual alone during the first two weeks and to call the Trace Center for emergencies only. Several subjects did call the first week after experiencing a major system failure which resulted in the inability to use the system. In these cases, the subject was told to refer to the manual for a solution. No information on which sections to consult was provided. In all cases, subjects were able to locate instructions for resetting the system without specific directions.

After two weeks of using the Trine System without any direct training by the Trace Center, subjects in Level 1 were asked to demonstrate basic functions of the aid. Five out of six subjects were able to get into different workspaces, delete characters, lines and pages, move the cursor in all directions, insert words and print on the built-in printer. In the case of the one subject who was not able to perform all these functions, the father was able to demonstrate them. The skills demonstrated by either the subjects themselves or their primary trainers suggest that it is possible to learn the basic operations of the Trine System using the training manual in conjunction with hands on exploration without external support or training. All subjects in Levels 1 and 2 agreed that they were provided with sufficient information to learn the basic functions of the Trine System and did not require any direct training. In addition, three subjects had incorporated the system into their classes or daily environment within two weeks. These findings support the marketing strategy of mail order delivery.

Of the subjects who completed the final questionnaire, 40% rated the effectiveness of the manual in training to use the aid as a 3 on a 4 point scale. Forty percent of the subjects rated the manual a 4 and only 20% rated the manual a 2. In addition, none of the subjects responded that they would have liked on going training sessions. Forty percent did indicate that they would have liked a follow-up training session and 20% would have liked an initial training session. Other suggestions for improving learning of the system were more frequent phone calls, more exercises in the manual, and troubleshooting charts.

One complicating factor must be noted. All subjects or the individual(s) responsible for their training had previous experience with the Epson HX-20. Therefore, success of mail order delivery to naive users cannot be determined from the results of the present field test.

B. Learning Methods

No general patterns for learning to use the system appeared. Each subject and the individual(s) working with them developed unique styles for learning new functions. These styles include exploring functions directly on the keyboard, reading the text in the manual, following the numbered directions in the manual, trying the examples provided, and referring to the graphics in the manual. All subjects did agree, however, that the tabs separating different topics were very helpful.

Ninety percent of the subjects used the stickers on the keyboard that were provided with the first 39 abbreviations. Sixty percent felt these were very helpful, 30% responded that they were somewhat helpful and one subject did not use the stickers.

On the other hand, 70% of the subjects did not use the cardboard keyboard reference chart that was provided with the first 39 abbreviations. Both subjects that did use the reference card responded that it was somewhat helpful.

The exercises in the Suggested Uses section of the manual were used by 90% of the subjects. Sixty percent felt they were somewhat helpful and 30% rated the exercises as very helpful.

When subjects were asked what strategies helped them learn their abbreviations, most responded that using them frequently was the most important factor. It was also recommended that a user get help to layout a plan for all the words and phrases to be used before entering them. One subject organized the vocabulary categorically rather than alphabetically. The following are examples from his vocabulary list:

2 - Places	9 - Greeting
B2 - Bank	H9 - Hello
M2 - Madison Area Technical College	T9 - Thank You

One subject assigned letters and numbers that were in close proximity to each other in order to reduce the distance he had to travel to type an abbreviation. Most subjects felt it was helpful to choose abbreviations with letters that were contained in the expanded word and several subjects printed the abbreviations on cards and taped them to their wheelchairs or inside covers of the Epson case.

C. Technical Aspects of Aid

1. Abbreviations

The software has the capacity to store 10,000 bytes of memory for abbreviations. Each abbreviation uses bytes according to the following formula:

ABBREVIATION = 5 BYTES + LENGTH OF ABBREVIATION + LENGTH OF EXPANSION

For example, if the abbreviation for "definition" was "defn", 19 bytes of memory would be used (5+4+10).

Based upon this formula, it is impossible to determine an exact number of abbreviations that may be stored. As a guide, it is possible to store about 700 5-6 letter words with 2-3 letter abbreviations.

None of the subjects filled the abbreviation storage to its capacity during the two month test period. The number of abbreviations that had been entered by subjects ranged from 0 to 124. Most of the subjects had added between 40 and 95 abbreviations and were using more than 75% of these.

2. Charging

It was necessary to charge the batteries of the Trine System more frequently than previously needed for the Epson HX-20 because the "sleep" mode required more battery power than turning the machine off with the main power switch.

Three subjects used the "sleep" mode during the day and turned the system off at night. They charged the batteries 2-4 times per week. The subjects who were able to use the on/off switch charged the batteries 1-2 times per week. None of the subjects were able to use the system for a full 20 hours as suggested in the Epson Users Manual.

Initially, subjects waited for the CHARGE BATTERY message to flash on the screen before charging the batteries. However, it seemed that the system crashed more frequently when the batteries were low. It was recommended that the subjects establish a routine for charging the batteries, such as every other day, in order to try to avoid system crashes.

3. Software Failures

Two general patterns of software failures were reported:

a) rolling garbage - sequences of control and letter characters fill up the workspace and begin to scroll
b) frozen screen - characters and commands cannot be entered into any area of the system

During the first phase of the beta test, most subjects experienced one of these software failures approximately once each week. The problem could be fixed by doing a system reset using the system reset command in the Toolbox in conjunction with the Reset button on the side of the aid. The system would then come back up and running. Subsequent to the beta test, several bugs were found in the software and were repaired.

Other idiosyncratic crashes also occurred occasionally. One subject reported that the workspaces would automatically fill up with blank information and the WORKSPACE FULL warning would flash. In this case, deleting the workspace pages solved the problem.

Two subjects using the Speechpac by ACS experienced a slowing down of the system. It took several seconds to switch between the Tracetalker and the Tracewriter. One subject had dropped the computer prior to the problem. In both cases, taking out the EPROMS and reinstalling them solved the problem.

4. Hardware problems

During the two months of field testing the following hardware problems occurred:

-1 broken cassette drive
-3 mother boards malfunctioning
-1 keyboard malfunctioning intermittently

Problems with 2 of the mother boards were precipitated by dropping the computer. Symptoms included the slow rate of switching between functions as described earlier, malfunctioning tape drives that worked well when placed on other units, broken internal clock, distorted speech, or inability to speak specific letter combinations.

In addition, several consultants and subjects commented on the small size of the screen display.

5. Software problems and future suggestions

Most of the major problems with the software were corrected during the beta test period. In addition, the keyboard arrangement was modified based upon feedback from the subjects. One subject using the Speechpac also noted that the speech quality with the Trine software was not as good as the original software. This should be explored further with Adaptive Communication Systems. Several additions were also suggested by subjects. These include:

-The ability to link any number of workspaces together should be possible. Currently, it is only possible to link all six workspaces.

-Auditory feedback, such as a beep, when pressing a key should be available.

-The line delete function should be available in the Title menu.

-The ability to save printer and other control/initialization strings should be incorporated so that if the system crashes the initialization strings are not lost.

-The ability to use abbreviations for initialization strings should be added.

-An exceptions table should be available for Tracetalker.

-The size of the writing storage system should be increased.

6. Manual problems and suggestions

Overall, most subjects felt that the manual was well-organized and easy to read and learn from. The most frequent complaint was that there was too much repetition which often caused confusion. One consultant suggested simplifying the introduction to the manual and numbering the sections to reduce the confusion. Another consultant also felt that the writing was juvenile and condescending at times.

A few individuals responsible for the training of a subject suggested that a brief description of all the functions and step by step instructions for "how to's" at the beginning of the manual would be helpful for people with limited time who needed to learn to use the system quickly.

Since the manual was incomplete during the time of beta testing, not all sections of the manual could be tested. Consequently, the majority of

the feedback received suggested that more documentation was necessary. Specifically, those subjects interfacing to external devices (printer, keyboard emulator with 2nd computer) required much more individual phone support since the manual did not cover these functions in detail. It is anticipated that the phone support needed for future placements will decrease now that these sections of the manual are completed.

One addition to the manual that was frequently suggested was a section on what to do if a problem occurs. A troubleshooting chart has been added to the final manual.

In addition, individual support was also required for abbreviation selection and organization. Although the manual did supply lists of suggested abbreviations and suggestions for choosing abbreviations, each individual's word list varied. Therefore, help was provided to make the individual organizations as effective as possible. It is unclear whether more information in the manual would solve this problem. One consultant felt that users would need individual attention to help optimize abbreviation selection and organization. Perhaps a specific manual written for speech pathologists and other trainers containing detailed information on selecting, organizing and using abbreviations would be beneficial.

D. Satisfaction with the Trine System

1. Overall

Overall, 60% (6 subjects) of the subjects were satisfied with the system, 30% (3 subjects) were very satisfied, and 10% (1 subject) were unsatisfied. Ninety percent (9 subjects) liked the abbreviation-expansion capability very much and one liked it. Seventy percent liked the system very much in comparison to their previous system, and 30% liked it a little better than their previous system. Seventy percent received very positive reactions from others, two subjects received positive reactions, and only one subject received negative reactions. In the latter situation, one of the school teachers did not want to accept the user's schoolwork on the paper from the built-in printer. The Trine can also print on external printers. All of the subjects responded that they would continue to use the system at least half of the time, 30% felt they would use it most of the time, and 50% said they would use it all of the time. Most of the subjects said they used the system a little more than their previous system, two subjects used it much more, and one subject used it a little less.

2. Features Liked Best

Although each subject and consultant liked various functions of the Trine System best, most of them noted the abbreviation-expansion capability, the multiple workspaces, the ability to change between workspaces or major function areas, and the ability to save work when the computer is turned off. One subject who was previously unable to turn the computer on and off especially liked the wake-up/sleep function. Other features that were mentioned frequently were portability, versatility, computer access, adjustability of hold and repeat time, and built-in printing.

3. Features Liked Least

a) Hardware:

One of the most frequent complaints was the reliability of the Epson computer itself. Several subjects had malfunctioning Epsons and became frustrated and reluctant to rely on technology. It is unclear why so many problems arose during these two months. It is possible that the Trine software taxed the computer to its maximum and used functions and memory locations that had not been accessed by earlier software. The small sample size and limited number of idiosyncratic problems were not sufficient to test this hypothesis or determine the cause of some of the problems. Use of the Epsons in the time since the beta test has not resulted in a similar number of Epson problems.

The small display on the Epson HX-20 was also a frequent complaint. It was difficult to adjust the display so that both the user and the communication partners could see the text on screen. In addition, it could not be used with visually impaired individuals.

Two of the subjects using the SpeechPac were also disappointed with the quality of speech output. One subject was particularly discouraged that the speech was highly unintelligible over the telephone.

One subject who was very weak did not like the layout of the keyboard. It was difficult for him to reach the top row of cursor movement keys which needed to be used frequently. This same individual also used many complex functions of the keyboard emulator and had a strong need to use an escape key which could only be used by entering a series of commands. In the final version of the software the keyboard has been rearranged and an escape key was added to accommodate these concerns.

Finally, some subjects did not like the frequency with which the battery needed charging. One subject would not use the sleep/wakeup function because it drained the battery faster than turning the system completely off.

b) Software:

The most frequent criticism of the software was the number of software failures during the beta test period. Some subjects became fearful of losing their work and avoided using the system for important documents. Repairs made to the software after the beta test subjects seems to have mostly cleared up this problem. One very heavy user, who uses the Epson for his daily work, has reported just one instance where he had a system lock-up, which he solved by resetting the computer.

Two Speechpac users felt that the quality of speech was poorer in the Trine System than in the original Lolec software and one Speechpac user felt that an exceptions dictionary was crucial for improving pronunciation while using correct spelling.

Several subjects disliked the volume of the attention key and complained that it was too soft to call attention to anything. The

attention key could be enabled to speak a phrase on a speech synthesizer to correct this problem.

One consultant also added caution about the abbreviation-expansion capabilities. Although it appears powerful on the surface, its inherent limitations become apparent when a substantial number of words need to be incorporated. Other consultants agreed that the abbreviation system was complex and would probably require professional assistance to use it effectively. No alternatives, however, were suggested for a keyboard based aid such as this.

E. Uses of the Trine System

1. Activities in which the system was most helpful

The Trine System was used most effectively in the following situations by subjects in Levels 1 and 2:

-schoolwork (spelling, writing assignments)
-writing letters
-supplementing speech when not understood or with unfamiliar listeners
-asking questions in class
-writing notes to self at work
-communicating in the community
-portable text entry
-computer access
-partial participation in notetaking
-assignments in which legibility was important
-phone calls using the Dectalk

The consultants and manufacturers in Level 3 felt that the system would be most useful in:

-educational settings
-work settings with limited writing requirements, or
-work settings with additional computer support
-situations with multiple needs
-situations requiring portability and/or speech output
-portable notetaking

2. Activities in which the system was least useful

The aid did not fulfill the following needs for subjects in Levels 1 and 2:

-inability to keep up with ALL notetaking in classes
-access to computer terminals that do not have serial output
-math calculations
-activity worksheets such as crossword puzzles or word search
-text editing very slow with keyboard emulator (due to limitation of keyboard emulator)
-inefficient access to second computer if have a targeted screen field or extensive use of function/control keys
-difficult to complete long writing assignments that required formatting

-limited workspace size for completing long written documents
-use of Speechpac over the phone

The manufacturers and consultants felt that the system was not appropriate for:

-individuals with low cognitive levels or confusion
-nonreaders or nonspellers
-individuals with poor vision
-terminally ill individuals with little motivation
-individuals with no keyboard skills
-profoundly physically disabled individuals
-ambulatory individuals
-large writing assignments

3. Activities that were not previously possible

The following is a list of tasks, activities, or functions that subjects were not able to accomplish prior to the Trine System:

-begin an assignment in class and finish it at home
-work on more than one subject or paper at one time
-use abbreviations
-take some notes in class
-interrupt writing to say something quickly
-turn on the computer independently

IV. Discussion

Overall, all of the beta test subjects were able to master the basic operation of the Trine System within the two month period. This is particularly useful information since our subjects covered a wide range of disabilities and cognitive levels.

However, the ability to master the system is not synonymous with its appropriateness for particular individuals. It became evident very early that the most successful users of the system were those who had the greatest need. This is not a surprising finding, yet it must not be overlooked in our prescription of technological aids for the disabled.

For example, one adult with cerebral palsy with skills at approximately a 3rd grade level was able to learn to operate the basic functions of the system in a structured situation. He operated the system based on memorization of where functions were located since the reading level of the menus was too difficult for him. He activated the keyboard using a single finger with a keyguard. Due to his severe physical involvement, this means of accessing the keyboard was extremely slow for him. He lived in an apartment with a full-time attendant, worked at a sheltered workshop, and received speech therapy each day. He relied on his own speech to communicate with all significant people in his life. He did not enjoy interacting with other disabled individuals and did not have a need to communicate with people in the community since his aide attended to all his daily environment needs. Prior to receiving the Trine software, he used his Epson HX-20 only when prompted. This pattern of use continued throughout the beta test period. Because he was a beta test subject,

greater demands for using the aid were placed upon him by his speech/language pathologist. However, he rarely used the system spontaneously. Although his typing speed did increase over the two month period, the appropriateness of such a complex aid in light of his limited needs remains questionable.

The three most satisfied subjects were all students - two in elementary school and one in high school. For these subjects, the system was quickly incorporated into their daily environment and they relied heavily upon the Trine to fulfill their daily writing needs. An aid that can meet multiple writing assignments and move easily between classes is a prime candidate for an educational environment. One subject in 5th grade was so excited with the new system that he commented, "college is gonna be a breeze!"

It also appears that the system is most useful as a portable writing device. One subject who is a university administrator found that he used the aid as a portable writing system to write memos, begin documents, and start other written work while away from his work station. He then transferred his files to his IBM where he would complete and edit his work. Since he was able to directly access his IBM keyboard, he felt the editing capabilities on the Trine were not as powerful and preferred to use the keyboard emulator mode mostly for dumping files.

As a conversational aid, the most satisfied subjects had some functional speech and used the Trine System for a back-up when they were not understood. These subjects commented on the ease of switching from the Tracewriter to the Tracetalker. Unfortunately, none of the three SpeechPac users were able to use the Trine System functionally. Two subjects experienced major hardware difficulties and one subject had very poor spelling skills and was still learning his abbreviations at the end of the two month period. For individuals, such as these, who are much more physically disabled, training requires more time before the system can be integrated into a daily routine.

Regardless of the level of subject satisfaction, results of the beta test suggest that minimal external professional support is needed to learn to use the Trine System. However, feedback regarding the weekly telephone interviews indicates that some professional contact provides a great deal of moral support. In addition, regularly scheduled telephone appointments greatly minimized the number of incoming calls as well as increasing the amount of problem solving that each subject engaged in since they were directed to call only for emergencies. Although the first couple of weeks required 15 - 45 minutes of telephone contact per subject, this time decreased dramatically within a few weeks. This suggests to manufacturers that promised telephone contacts for the first month after delivery would be an effective method of providing external support and minimizing constant incoming questions.

In conclusion, the Trine System is a powerful and versatile aid that can be beneficial for a wide range of users. Manufacturers and clinicians however should consider the needs of an individual and the uses of the Trine System before placement. Consideration should also be placed upon a method for external support if needed. Results of the two month beta test suggests that the Trine System can meet the basic communication and writing needs of a person in educational, vocational and daily living situations.

APPENDIX A

____Please consider _____ for a test subject for the new software program for the Epson HX-20. I have completed the information below as completely as possible.

____I do NOT wish to be considered as a test subject.

_____
signature date

Name of client _____
Name of person completing form_____
relationship to client_____
Phone # _____ best time(s) to call_____

Please answer the following questions as completely as possible:

1. What is this person's current living situation? (home, nursing home etc.) Please list the number of people living in this situation (parents, siblings, residents etc).

   _____

2. Is this person in school? ___Y ___N If yes, what grade? ____

3. Is this person working? ___Y ___N If yes, what type of job? _____

4. Please check the communication systems that apply and briefly describe the situations that they are used most often in. Also indicate how long a system has been in use.

type of system	used in past		used now		how long has it been used?	in what situations?
signing	___Y	___N	___Y	___N		
speech	___Y	___N	___Y	___N		
communication board	___Y	___N	___Y	___N		
typing	___Y	___N	___Y	___N		
writing	___Y	___N	___Y	___N		
Epson	___Y	___N	___Y	___N		
other computer	___Y	___N	___Y	___N		
please specify what kind_____						
electronic aid	___Y	___N	___Y	___N		
please specify what kind:_____						
other	___Y	___N	___Y	___N		
please specify:_____						

5. How does this person control their communication system(s)? (point with one finger, 2 finger typing, mouthstick, etc.)

   _____

6a. What accessories and/or modifications are needed? (keyguard, switches etc.)

   _____

b. Does this person use 1FIN? ____Y ____N
If yes, how many abbreviations are stored?_____
How many abbreviations are used? ___0% ___25% ___50% ___75% ___100%
How often are they used? ___never ___rarely ___sometimes ___often
c. Does this person use Skiwriter? ____Y ____N
d. Does this person use a speech synthesizer? ____Y ____N
If yes, how many abbreviations are stored? _____
How many abbreviations are used? ___0% ___25% ___50% ___75% ___100%
How often are they used? ___never ___rarely ___sometimes ___often

7. Have any tests been administered recently? If not please estimate the grade level at which the person is functioning.

	name of test	score	date	estimated grade level
a) vocabulary				
b) receptive language				
c) reading				
d) spelling				
e) math				

8. Can this person identify the initial letters of words? _____Y _____N

9. Can this person alphabetize words? _____Y _____N

10. Does this person know bliss, rebus or some other symbol system? ___Y ___N

11. How much writing does this person need to do? for what purposes?

	activity	how often?
example	homework	~2 hrs. per night
a)		
b)		
c)		
d)		
e)		

12. What activities involve conversation? how often? with whom?

	activity	how often?	with whom?
example	speech therapy	2 times/wk.	(name)
a)			
b)			
c)			

13. Please check all environments this person is involved in and how often.

		~hrs./wk.			~hrs./wk.
1) home	_____	_____	6) shopping	_____	_____
2) school	_____	_____	7) travel	_____	_____
3) therapy	_____	_____	8) sports	_____	_____
4) camp	_____	_____	9) organizations	_____	_____
			specify:	_____	
5) church	_____	_____	10) other	_____	_____
			specify:	_____	

14. What problems does this person have with their current communication system. Please be as specific as possible.

_____
_____
_____

15. Who would be responsible for helping this person learn the new software system for the HX-20 computer? (parents, attendant, teacher, spouse, therapist) Would these people also be willing to fill out periodic questionnaires, administer weekly quizzes and help with other data collection procedures? How much time do each of these people have to help with this?

	name	phone #	relationship	time available
a)	_____	_____	_____	_____
b)	_____	_____	_____	_____
c)	_____	_____	_____	_____

16. Are any vacations planned between November and February? ___Y ___N
When? _____ How long will this person be out of town? _____
When is winter break in the school (if applicable)?_____

Thank you very much for taking time to complete this form. We will be contacting you again soon. Looking forward to meeting you.

Sincerely,

_____
Susan Fishman, M.S.
Beta Test Coordinator

APPENDIX B

Below is a list of activities. Please review this carefully and check all those that the subject currently engages in, will need in the near future, or would like to do if assistance were available. Please describe how each of the activities that are checked is currently being completed.
(e.g., note taking - aide xeroxes other students notes)

_____write a letter

_____learn letter identification

_____fill out a job application form

_____learn sight-word recognition

_____write a book report

_____copy assignments from the board write down homework assignments

_____talk to friends over the phone

_____write down calendar appointments

_____participate in group meetings

_____write stories, research papers, poetry, or news articles

_____complete math assignments/workbook problems

_____address envelopes

_____take spelling tests

_____deliver an report/presentation

_____balance a checkbook

_____write an outline

_____use an Apple IIE computer and software

_____answer questions about a story

_____participate in class discussions

_____take notes in class

_____write language experience stories

_____other (please specify)

Now go back and put a star (*) by the 5 activities that are most important or most often engaged in.

Thank you very much for taking time to complete this form. I will be contacting you again soon.

Sincerely,

Susan Fishman

APPENDIX C

CHECKLIST OF FUNCTIONS

read in manual	try on Trine	
		BASIC OPERATION
_____	_____	turn main power on and off
_____	_____	wake up
_____	_____	sleep
_____	_____	get into the system menu
_____	_____	get into Tracewriter (writing)
_____	_____	get into Tracetalker (conversing)
_____	_____	get into the Toolbox menu
_____	_____	get into the Accessing menu
_____	_____	use the Attention key
_____	_____	go to a previous menu
_____	_____	get into an options menu
_____	_____	type 1 capital letter
_____	_____	type in all capital letters
_____	_____	type a special symbol (!,#,&)
_____	_____	write on the screen
_____	_____	do a partial reset
_____	_____	do a complete reset
_____	_____	charge batteries
		EDITING FUNCTIONS
_____	_____	delete a letter
_____	_____	delete a line
_____	_____	delete a workspace
_____	_____	get into insert mode
_____	_____	get out of insert mode
_____	_____	insert a letter
_____	_____	insert a line
		PRINTING FUNCTIONS
_____	_____	print on built-in printer
_____	_____	print on external printer
		CONVERSATION FUNCTIONS
_____	_____	get speech synthesizer ready
_____	_____	speak out each letter with speech synthesizer
_____	_____	speak each word
_____	_____	speak only when press [RETURN]
_____	_____	speak out a workspace in Tracewriter
_____	_____	interrupt writing to say something

WORKSPACE FUNCTIONS

_____ _____go to a different workspace
_____ _____title a page
_____ _____link workspaces together

CURSOR MOVEMENT

_____ _____backspace
_____ _____move cursor one space right
_____ _____move cursor one word left
_____ _____move cursor one word right
_____ _____move cursor to beginning of line
_____ _____move cursor to end of line
_____ _____move cursor one line up
_____ _____move cursor one line down
_____ _____move cursor one screen up
_____ _____move cursor one screen down
_____ _____move cursor to top of workspace
_____ _____move cursor to bottom of workspace

ABBREVIATION FUNCTIONS

_____ _____manually expand an abbreviation
_____ _____change QuicKey to Autoexpand mode
_____ _____"unexpand" a word when in Autoexpand mode
_____ _____add an abbreviation
_____ _____change an abbreviation
_____ _____remove an abbreviation
_____ _____load list of abbreviations from tape
_____ _____store abbreviations on tape
_____ _____print list of abbreviations
_____ _____look at abbreviations with SHOW
_____ _____enter pronunciation exception with Prefix mode

ACCESSING A SECOND COMPUTER

_____ _____connect a keyboard emulator
_____ _____type on a second computer
_____ _____put a page of text on the computer

MAKING ADJUSTMENTS

_____ _____change the keyboard hold time
_____ _____set up external printer
_____ _____change volume of SpeechPAC
_____ _____change pitch of SpeechPAC
_____ _____change rate of SpeechPAC
_____ _____change filter of SpeechPAC
_____ _____enter a message for the Attention key

APPENDIX D

COMPUTER QUESTIONNAIRE

1. How many times did you use the Trine System this week with another computer or printer?

2. What did you use the second computer or printer for?

_____
_____
_____

3. What did you like best about using the Trine System?

_____
_____
_____
_____
_____

4. What did you like least about using the Trine System with a 2nd computer or printer?

_____
_____
_____
_____
_____

5. How could the Trine System be improved for using 2nd computers and printers?

_____
_____
_____
_____
_____

6. Rate how well you like using the Trine System to access a 2nd computer or printer:

1 2 3 4 5
do not like like very much

7. Rate how the Trine System compares to your previous system for accessing a computer:

1 2 3 4 5
much worse much better

WRITING APPLICATIONS QUESTIONNAIRE

1. Estimate how many times and how much time you used the Trine System this week for the following writing tasks?

		#/wk	hrs/wk
a.	_____	_____	_____
b.	_____	_____	_____
c.	_____	_____	_____
d.	_____	_____	_____
e.	_____	_____	_____

2. What did you like best about using the Trine System?

_____
_____
_____
_____
_____

3. What did you like least about using the Trine System to do each task?

_____
_____
_____
_____
_____

4. How could the Trine System be improved for any of these?

_____
_____
_____
_____
_____

5. Rate how well you like using the Trine System for writing tasks?

1 2 3 4 5
do not like like very much

6. Rate how the Trine System compares to your previous system for writing tasks?

1 2 3 4 5
much worse much better

CONVERSING APPLICATIONS QUESTIONNAIRE

1. Estimate how many times and how much time you used the Trine System this week during the following conversational activities? Then record who you interacted with during each activity (parents, group, classmates...)

		#/wk	hrs/wk	who?
a.	_____	_____	_____	_____
b.	_____	_____	_____	_____
c.	_____	_____	_____	_____
d.	_____	_____	_____	_____
e.	_____	_____	_____	_____

2. What did you like best about using the Trine System?

_____
_____
_____
_____
_____

3. What did you like least about using the Trine System in these activities?

_____
_____
_____
_____
_____

4. How could the Trine System be improved for any of these?

_____
_____
_____
_____
_____

5. Rate how well you like using the Trine System for conversation or speaking activities?

1 2 3 4 5
do not like like very much

6. Rate how the Trine System compares to your previous system for conversation?

1 2 3 4 5
much worse much better

APPENDIX E

PROBLEM LOG

date	time	activity	has problem occurred before?	type of problem (M,S,H)*	description of problem	attempted solution(s)

*M = problem in the manual
H = problem with the hardware (the Epson computer)
S = problem with the software program

APPENDIX F

SUMMARY OF RESULTS

1) Rate your overall satisfaction with the Trine System.

1	2	3	4
very unsatisfied			very satisfied

2) Rate the effectiveness of the manual in training you to use the aid.

1	2	3	4	NA
not effective at all			very effective	did not use

3) Rate how well you like the abbreviation-expansion capability.

1	2	3	4	NA
did not like			like very much	did not use

4) Rate how you liked the Trine System compared to your previous system.

1	2	3	4
did not like			like very much

5) Rate how others reacted to the Trine System.

1	2	3	4
very negative			very positive

6) Rate the speed of using the Trine System as compared to your previous system.

1	2	3	4	5
much slower	slower	about the same	faster	much faster

7) Will you continue to use the Trine System?

1	2	3	4	5
not at all	sometimes	1/2 the time	most of the time	all the time

8) How much do you use the Trine System in comparison to your previous system?

1	2	3	4	5
much less		about the same		much more

9) What expectations do you have for technological aids? (may choose more than 1)

____I will rely on technology more than I used to.
____I will rely on technology about as much as before.
____I will rely on technology less than I used to.
____I am more comfortable with technology.
____I am less comfortable with technology.

COMMENTS:

10) Which features did you like best?

11) Which features did you like least?

12) In what activities/situations is it most helpful?

13) In what activities/situations is it least helpful? What needs did the aid NOT fulfill?

14) What things were you able to do with the Trine System that you were unable to do before?

15) What could have helped you make learning easier?

16) What suggestions do you have for learning abbreviations?

17) How helpful were the stickers?

____very helpful
____somewhat helpful
____not very helpful
____not helpful at all
____did not use

18) How helpful were the cardboard keyboard charts?

____very helpful
____somewhat helpful
____not very helpful
____not helpful at all
____did not use

19) How helpful were the exercises in the suggested uses section?

____very helpful
____somewhat helpful
____not very helpful
____not helpful at all
____did not use

20) Would you have like more help from the Trace Center? What kind of help?

____more phone calls
____more observations
____initial training session
____follow up training sessions
____ongoing training sessions
____more exercises in the manual
____other: (please specify)

21) What hardware problems did you have?

22) What repairs have you needed since you received your Epson? Please list the approximate date and how much it cost for each repair.

1)

2)

3)

4)

23) ANY OTHER COMMENTS YOU HAVE

Please go through the checklist one last time. For each function, check whether you liked it alot, it was OK or you did not like it. For the things that you do not like, please write a reason next to the function. If you did not use a function, just leave it blank.

LIKED ALOT	JUST OK	DID NOT LIKE		REASON DID NOT LIKE
			BASIC OPERATION	
_____	_____	_____	turn main power on and off	
_____	_____	_____	wake up	
_____	_____	_____	sleep	
_____	_____	_____	get into the system menu	
_____	_____	_____	get into Tracewriter (writing)	
_____	_____	_____	get into Tracetalker (conversing)	
_____	_____	_____	get into the Toolbox menu	
_____	_____	_____	get into the Accessing menu	
_____	_____	_____	use the Attention key	
_____	_____	_____	go to a previous menu	
_____	_____	_____	get into an options menu	
_____	_____	_____	type 1 capital letter	
_____	_____	_____	type in all capital letters	
_____	_____	_____	type a special symbol (!,#,&)	
_____	_____	_____	write on the screen	
_____	_____	_____	do a partial reset	
_____	_____	_____	do a complete reset	
_____	_____	_____	charge batteries	
			EDITING FUNCTIONS	
_____	_____	_____	delete a letter	
_____	_____	_____	delete a line	
_____	_____	_____	delete a workspace	
_____	_____	_____	get into insert mode	
_____	_____	_____	get out of insert mode	
_____	_____	_____	insert a letter	
_____	_____	_____	insert a line	
			PRINTING FUNCTIONS	
_____	_____	_____	print on built-in printer	
_____	_____	_____	print on external printer	

LIKED ALOT	JUST OK	DID NOT LIKE	REASON DID NOT LIKE
		CONVERSATION FUNCTIONS	
_____	_____	_____get speech synthesizer ready	
_____	_____	_____speak out each letter with speech synthesizer	
_____	_____	_____speak each word	
_____	_____	_____speak only when press [RETURN]	
_____	_____	_____speak out a workspace in Tracewriter	
_____	_____	_____interrupt writing to say something	
		WORKSPACE FUNCTIONS	
_____	_____	_____go to a different workspace	
_____	_____	_____title a page	
_____	_____	_____link workspaces together	
		CURSOR MOVEMENT	
_____	_____	_____backspace	
_____	_____	_____move cursor one space right	
_____	_____	_____move cursor one word left	
_____	_____	_____move cursor one word right	
_____	_____	_____move cursor to beginning of line	
_____	_____	_____move cursor to end of line	
_____	_____	_____move cursor one line up	
_____	_____	_____move cursor one line down	
_____	_____	_____move cursor one screen up	
_____	_____	_____move cursor one screen down	
_____	_____	_____move cursor to top of workspace	
_____	_____	_____move cursor to bottom of workspace	
		ABBREVIATION FUNCTIONS	
_____	_____	_____manually expand an abbreviation	
_____	_____	_____change QuicKey to Autoexpand mode	
_____	_____	_____"unexpand" a word when in Autoexpand mode	
_____	_____	_____add an abbreviation	
_____	_____	_____change an abbreviation	
_____	_____	_____remove an abbreviation	
_____	_____	_____load list of abbreviations from tape	
_____	_____	_____store abbreviations on tape	
_____	_____	_____print list of abbreviations	
_____	_____	_____look at abbreviations with SHOW	
_____	_____	_____enter pronunciation exception with Prefix mode	
		ACCESSING A SECOND COMPUTER	
_____	_____	_____connect a keyboard emulator	
_____	_____	_____type on a second computer	
_____	_____	_____put a page of text on the computer	

LIKED ALOT	JUST OK	DID NOT LIKE	REASON DID NOT LIKE

MAKING ADJUSTMENTS

_____	_____	_____	change the keyboard hold time
_____	_____	_____	set up external printer
_____	_____	_____	change volume of SpeechPAC
_____	_____	_____	change pitch of SpeechPAC
_____	_____	_____	change rate of SpeechPAC
_____	_____	_____	change filter of SpeechPAC
_____	_____	_____	enter a message for the Attention key

APPENDIX G

EVALUATION QUESTIONNAIRE

1. What features of the Trine System did you like best?

2. What features did you like least?

3. Which features would you change and how?

4. In what situations/activities would you think the Trine System would be most useful?

5. In what situations/activities is the Trine System inappropriate? What needs did the aid NOT fulfill?

6. Do you feel the manual provides enough training? What could have helped make learning easier?

7. Did you experience any major problems? If so, what?

8. What suggestions do you have for learning abbreviations?

9. Any other comments

APPENDIX H

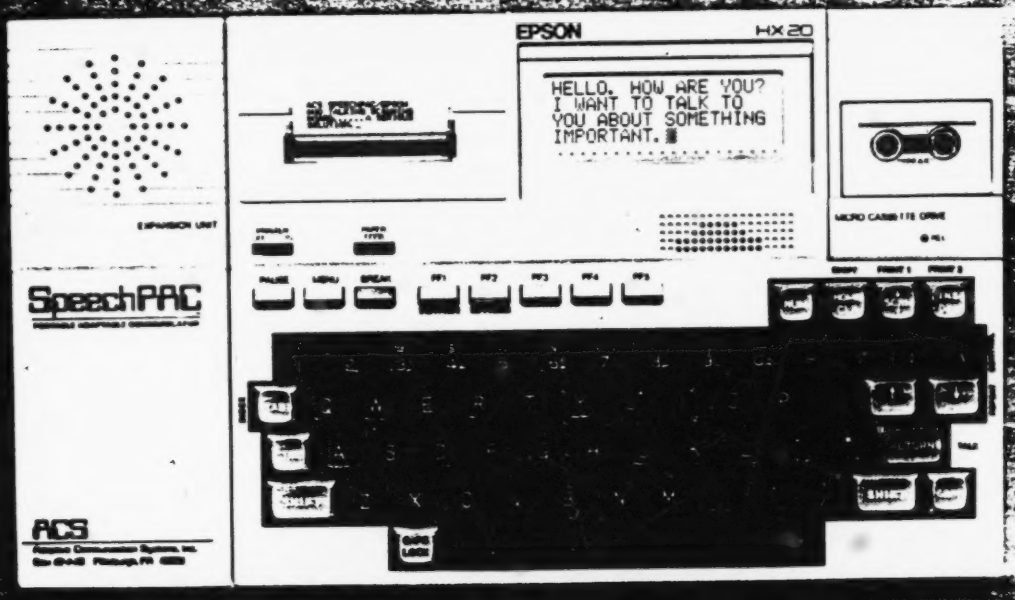
MANUFACTURING QUESTIONS

What do you see as the most optimal marketing plan for the Trine System?

After reviewing this system, please comment briefly on the advantages and disadvantages of each of the following marketing strategies: open distribution, exclusive distribution and liscense agreement (descriptions of each strategy have been included)

Would you be interested in distributing and providing support for this system? If yes, which marketing strategy would you be most interested in and why?

A SERIOUS SOLUTION...TO A SERIOUS PROBLEM



The new ACS SpeechPAC/Epson

The new ACS SpeechPAC/Epson is a technological breakthrough in design, function, and adaptation. It provides the nonverbal (child or adult) with communication capabilities never before available. SpeechPAC/Epson is what you need it to be.

AS A COMMUNICATOR: Turn it on and SpeechPAC automatically becomes the easiest to use, most advanced portable communication system available for non verbal handicapped persons. It is 100% user programmable and can store hundreds of key sentences in memory for quick transfer to voice out-put or print.

TEXT TO SPEECH: Type any English words, numbers, sentences or paragraph; press TALK and SpeechPAC speaks out the entry. There are no complicated procedures or instructions to learn.

EASY TO PROGRAM: Simply press one button and the screen displays the three easy instructions for programming. No computer knowledge is necessary to use the SpeechPAC/Espon as a communication system.

LOGICAL LETTER CODING: An ACS exclusive program for non-verbal handicapped persons. "LOLEC" gives a quick, uncomplicated method for the user to program and retrieve complete sentences (up to 250 characters long) from memory with a single key stroke. *EXAMPLE:* Every sentence has a "Logical Thought" and every thought has a "Logical Letter Code." Program DW to SPEAK "I would like to have a *DRINK* of *WATER.*" Once programmed, the user simply enters DW, pushes TALK and the voice output is the entire sentence.
Text to speech and numerous letter codes can be mixed together in any random sequence to create unlimited vocabulary potential.

MEMORY CAPACITY: Several hundred sentences can be stored for retrieval by "Logical Letter Coding". The SpeechPAC/Epson can store approximately 15,000 characters.

TRINE SYSTEM: SpeechPAC can be ordered with the new TRINE SYSTEM developed at the University of Wisconsin-Madison Trace Center. TRINE SYSTEM is a method of writing, conversing and accessing other computers for people with motor disabilities.
Many handicapped nonverbal persons need an easy to use, balanced method for effective communication, writing and working with computers. The TRINE SYSTEM is unique in making these necessary functions convenient and easily accessible.
Previous testing has shown that the TRINE SYSTEM can be learned in a few hours without computer knowledge.

SPEECHPAC FEATURES: SpeechPAC talks for approximately 24 hours using the rechargeable batteries of the Epson computer. You can create Male, Female, and Child like voices.

ACCESSORIES: Wheelchair Mounting Kit, Keyguards, Carrying Case, Telephone Modem, External Amplifiers, Emulator for connection to Apple or Franklin computers, Protective moisture proof keyboard cover.

SIZE: 8½ x 14½ x 1¾" WEIGHT: 5 pounds

ACS Expanded Membrane Board

The Expanded Membrane board plugs into the SpeechPAC to accommodate the user with poor pointing skills. It has 128 "Light Touch" positions approximately 1" square.
The blank positions can be easily programmed to be sentences or phrases for quick "voice output" of customized phrases. The overlay can also be converted to all pictures.
With the addition of an Emulator Card or the Adaptive Firmware Card, it will connect to an operate an Apple 2e,2 + and IBM PC computer.

ACS

Adaptive Communication Systems, Inc.
Box 12440T Pittsburgh, PA 15231

412/264-2288

THE WORDS+ TRINE SYSTEM

The Words+ Trine System is a communication aid developed to be a tool for writing, conversing and accessing computers, for people with motor disabilities. Trine means threefold and in balance. This communication aid is just that, an equal balance between these three functions. The Words+ Trine System is a modular design developed around an off-the-shelf, general purpose, portable computer. The system will allow the user to become more independent within their environment.

ACKNOWLEDGEMENT

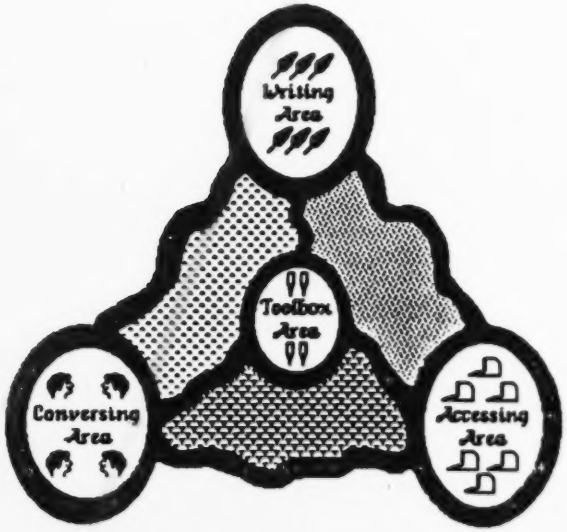
The Words+ Trine System was developed at the Trace Research and Development Center at the University of Wisconsin-Madison, and funded by the Office of Special Education of the U.S. Department of Education. Words+ Inc. contributed through system evaluation and design recommendations.

words+, inc.

"unlocking the person"

... the leader in applying personal computers in augmentative communication

the Words+ Trine System



Trace Research and Development Center

from

words+, inc.

"unlocking the person"

1125 stewart court, suite d
sunnyvale, california 94086

(408) 730-9588

WORDS+ TRINE SYSTEM

A New "Threefold" Augmentative Communication System

"Trine" - Threefold and Balanced

The new Words+ Trine System combines writing, conversing and accessing.

CONVERSING

The user can utilize the Words+ Trine System to communicate by typing the word or message and it will appear on the built-in screen and be spoken by the high-quality speech synthesizer. The same message can be printed using the computer's own printer.

WRITING

The Words+ Trine System can be used as a full word processing tool. It allows you to construct and edit written material. This means the user can correct, add and delete information without having to erase wanted words or phrases first!
The writing area consists of six work spaces. This allows the user to do many things.

First, each work space can be used for a different topic. As an example; one work area could be used for writing letters to family or friends, another area could be used for school work, while yet another work area could be used for developing lists. All of these work spaces can be used at the same time! Not only that, but the Words+ Trine system can switch between writing and conversing without disrupting either area.

ACCESSING

The Words+ Trine System can be used to access a second computer! This means that the user has access to any software that can run on the alternate computer. As an example; a person can use a specific software program that is appropriate for a task they wish to complete. This further expands the use of the system, making the options almost limitless.

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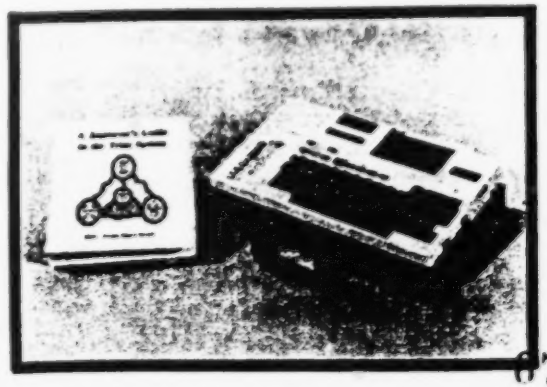
OTHER FEATURES

Excellent Speech Quality is an inherent feature of the Words+ Trine System and separates it from similar devices.
Abbreviation Expansion is an exciting new program within the Words+ Trine System that allows the user to store and recall words and phrases with one or two key strokes. This feature increases speed of communication and reduces the effort needed to recall long and sometimes difficult-to-reproduce items. The Micro Cassette Tape is used to store abbreviations and information from the Notebook. This feature allows you store witten entries so they can be organized and saved for recall at a later time. Additional tapes can be used to store information as needed.



The Design and Testing of a Tutorial Manual That Allowed Users To Learn a Multifunction Aid System Without Expert Support

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TRACE RESEARCH AND DEVELOPMENT CENTER ON
COMMUNICATION, CONTROL AND COMPUTER ACCESS FOR HANDICAPPED INDIVIDUALS
UNIVERSITY OF WISCONSIN-MADISON

Abstract: To see if a complex aid system could be learned from a manual without direct support from experts, a special tutorial manual was designed for a multifunction, computer-based, communication aid system called the Trine System. During the first two weeks of the Trine System's beta test, 13 users with their parents, therapists, and teachers were asked to learn the Trine System with the guidebook without contact with people who knew the system. After two weeks, six of the users were asked to demonstrate what they had learned. Five of the six users, as well as the father of the sixth user, had mastered the basics of the system.

In addition, five of the users and ten parents, teachers, and therapists were asked, "How likely is it that a user could learn the Trine System by using it with the guidebook without personal help from the supplier?" Eleven of these people rated this as "Very Likely" and the other four rated it as "Likely". No one rated it as "Unlikely" or "Very Unlikely".

The primary goal of the guidebook design was to allow people with normal intelligence who had no computer or complex aid experience to learn the Trine System without expert help from a printed document as physically accessible as possible to the disabled user. Secondarily, the guidebook was designed for small manufacturers to easily produce, maintain, and update in very small printing runs. To accomplish these goals, the Trine guidebook design makes use of structured documentation techniques, positive multimode presentations, and desktop publishing. As a result, the design includes many features not often found in aid system manuals. This study suggests that emulating these features may help users get the most from their aid systems and reduce the cost to manufacturers and dealers of personal support.

Question: Can Better Manuals Allow Users to Learn Aid Systems Without Expert Help? Aid systems are often underutilized because users are unable to learn from the documentation provided and are unable to get the expert support they need locally. Many users can't get expert help locally because they are in less populated areas and/or they are dealing with a manufacturer who has no local aid system integrator. In this case, many manufacturers are forced to provide aid systems via the mail and support them directly. For manufacturers who must use their technical experts to support systems directly, this can be doubly bad. It not only adds to the cost of the systems, but by tying up their designers, it also slows down the development of improved systems.

It is often suggested that if manufacturers would spend more effort developing quality tutorial manuals, they could mitigate these support problems. The better the manual, the less direct support they have to do. In the best case scenario, the tutorial manual would be good enough to allow users along with their local support group (parents, teachers, therapists, etc.) to master their aid systems without any additional help from experts on that particular aid system.

Testing: The Trace Center Tested the Idea In Developing the Trine System. The Trace Center decided to test the idea that a good tutorial manual would allow users to learn a complex aid system without help from anyone already an expert on that particular system. As a result, two major activities were added to the development of a portable computer based communication aid system called the Trine System. First, great emphasis was put on the design and production of a tutorial manual that we call *A Journeyer's Guide to the Trine System* (hereafter referred to as the Trine guidebook). Second, part of the beta test of the Trine System was designed to see whether or not people could learn to use the communication aid system from the guidebook and their own experimentation, without help from people familiar with the system.

What Is the Trine System Like? In order to understand how effective the tutorial guidebook it is necessary to understand what the Trine System is like and what there is to learn. The Trine System is a multifunction aid system whose primary components are a software program, an Epson HX-20 portable computer, and an optional speech synthesizer. It has three main functions: providing a portable writing system; providing a portable speech output system; and providing access to a standard computer through a standard keyboard emulating interface.

The Trine System is designed to be easy to use by beginners while providing flexibility for more advanced users. It uses menus and dedicated keys for most functions. However, it's flexiblity means there is a lot to learn if a person wants to master everything. It has 143 different menus and there are about 33 functions on dedicated keys including 22 editing functions. Four of the keys cycle sequentially through three different states. The Trine System offers six different writing workspaces, a conversation workspace, and keyboard emulating interface workspace. It can use a built-in or external printer, and a built-in or external speech synthesizer. It has a two mode abbreviation expansion system that can store about 400 twelve character user programmable expansions. A built in cassette drive stores abbreviations as well as up to 18 pages of writing organized into three different volumes. Almost all program parameters are user settable. To cover all these features the guidebook is itself 327 pages with 123 major topic articles.

Who Were the Test Users? As part of the Trine System evaluation a beta test was carried out with six users from Wisconsin (Level 1 users) and seven users from other areas (Level 2) users. Figure 1 profiles the test users, showing their sex, age, grade level, and whether or not they walk or use a speech synthesizer. Level 1 users ranged in age from 11 to 40 and in grade level from third to the second year of college. Users in Level 2 ranged in age from 10 to 47 and in grade level from third through college. Each group had one female. Two of the level 1 children walk, and one Level 1 person along with three Level 2 persons use a speech synthesizer with their Trine System.

User	Sex (Female / M)	Age	Grade	Ambulatory (Yes / N)	Uses Speech Synthesizer (Yes / N)
			Level 1		
#1	M	11	3	N	Yes
#2	M	40	4	N	N
#3	M	11	5	Yes	N
#4	Female	11	5	Yes	N
#5	M	15	4	N	N
#6	M	30	14	N	N
			Level 2		
#7	M	47	16+	N	N
#8	M	15	9	N	N
#9	M	10	3	N	Yes
#10	M	27	12	N	Yes
#11	Female	17	11	N	Yes
#12	M	17	3	N	N
#13	M	15	9	N	N

Figure 1: Profile of Test Users

An important point to keep in mind about the beta test users is that in order to participate they had to already have an Epson HX-20 computer because the project could not afford that many computers. This means that they all had some experience with the Epson computer before they got the Trine System. Thus, they were not naive users. However, we feel that their experience still relates to other beginning users because the Trine System is very different from software that they used previously. In fact, they may have had some extra problems due to expectations about how they thought it should work from their other experience.

The Test Users Had Only the Trine Guidebook For Support During the First Two Weeks: The overall beta test was designed to evaluate the Trine System as a communication aid system and the results are given in the Trine beta test report[1]. One procedure of the beta test was designed to see if the six Level 1 users could learn the basics of the Trine System without help from experts. These people were

given the Trine System and the guidebook and asked to learn it without help from the Trace Center. If they called with a problem they were preferred to the guidebook in general, not to any particular section.

Results: Five of Six Users Mastered the Basics In Two Weeks. After two weeks the Level 1 users and their associated support persons came to the Trace Center for evaluation. Susan Fishman, beta test coordinator for the project, then tested them to see whether they had mastered the basics of Trine System use. The following is her conclusion in the beta test report:

After two weeks of using the Trine System without any direct training by the Trace Center,subjects in Level 1 were asked to demonstrate basic functions of the aid. Five out of six of the subjects were able to get into different workspaces, delete characters, lines, and pages, move the cursor in all directions, insert words and print on the built-in printer. In the case of the one subject who was not able to perform all these functions the father was able to demonstrate them. The skill demonstrated by either the subjects themselves or their primary trainers suggest that it is possible to learn the basic operation of the Trine System using the training manual in conjunction with hands on exploration without external support or training. All subjects in Levels 1 and 2 agreed that they were provided with sufficient information to learn the basic functions of the Trine System and did not require any direct training. In addition, three subjects had incorporated the system into their classes or daily environment within two weeks.[1]

What The Test Users, Their Parents, and Clinicians Thought About Learning From the Trine Guidebook: Between the two and four week point Level 1 and Level 2 users were interviewed on their thoughts about the guidebook. In three cases parents and clinicians were interviewed instead of the users because they were learning the system themselves and then teaching the users who were at the third and fourth grade level. In addition, two parents and five clinicians who also learned the Trine System were interviewed.

The five users, five parents, and five clinicians interviewed about the guidebook were asked, "How likely is it that a user could learn the Trine System from using it with the guidebook (with help from family, friends, and inexperienced clinicians) without personal help from the the supplier." They were given four choices: Very Unlikely; Unlikely; Likely; or Very Likely. The results are shown in Figure 2. Eleven of these people rated this as "Very Likely" and the other four rated it as "Likely". No one rated it as "Unlikely" or "Very Unlikely".

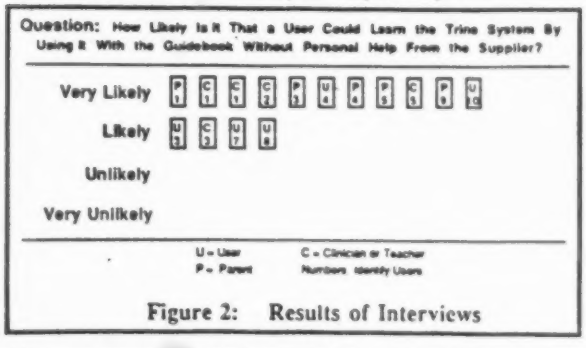

Question: How Likely Is It That a User Could Learn the Trine System By Using It With the Guidebook Without Personal Help From the Supplier?
Very Likely
Likely
Unlikely
Very Unlikely
U = User
P = Parent
C = Clinician or Teacher
Numbers Identify Users

Figure 2: Results of Interviews

Thus, users, parents, and clinicians strongly endorsed the idea that the Trine System could be learned from a tutorial manual without the need for training by experts in the system. Considered with the results of the beta test finding discussed above, this indicates it is likely that manuals similar to *A Journeyer's Guide to the Trine System* can reduce the need for personal training and other direct support for other complex aid systems.

Design: The Trine Guidebook Design Makes Use of Structured Documentation Techniques, Positive Multimode Presentations, and Desktop Publishing. The primary goal of the guidebook design was to create a printed document as physically accessible as possible that would allow a disabled user with normal intelligence, a sixth grade reading level, and no computer or multifunction aid experience to learn the Trine System without expert help. Secondarily, the guidebook was designed for small manufactures to easily produce, maintain, and update in printing runs of as few as 50 copies. To accomplish this three major approaches were incorporated into the design.

The first major approach used is called structured documentation. The author learned the structured documentation approach from a 2 day workshop, Structured Documentation, presented by The American Institute for Professional Education (Carnegie Bldg., 100 Kings Rd., Madison, NJ 07940, (201)377-7400). According to the presenter, Lynn Harris, structured documentation evolved from the intense documentation and training requirements for computer software in companies like IBM, Wang, and Digital Equipment Co. Its overriding goal is to make it possible to design, produce, and maintain effective documentation in the most cost effective and time effective way. Structured documentation can be done successfully by any size company. The three main features of structured documentation are that it is: 1) modular, 2) structured in a top-down fashion, and 3) written using clear communication techniques

The second major approach was to design, write, typeset, print and assemble the guidebook in-house using the Apple Macintosh computer system. This has since come to be called desktop publishing. Because most small aid system companies print 100 or fewer manuals at a time, the cost to produce quality tutorial manuals using traditional publishers and bookmaking techniques is prohibitive. Desktop publishing offers the possibility to aid system companies of making quality manuals. The overall design and layout of the guidebook was strongly determined by technical limitations of the Macintosh. It turned out that these limitations severely increased the effort required to create the guidebook. Happily, most of these limitations have been removed in the latest equipment.

The third major approach was to incorporate new ideas about different cognitive learning styles by using a positive multimode presentation of key information. To communicate effectively to a wide variety of people, the guidebook presents the same information in a variety of ways. Information was always presented positively in the logical sense. Negations were actively eliminated. The five main types of presentation were: 1) a summary, 2) straight text, 3) a follow along example, 4) a realistic illustration of the actual device, and 5) a tabular instruction list. This redundancy is relatively cheap when implemented with desk top publishing equipment. It was found from interviews with the learners that even in our small sample of 15 that the group was almost evenly split for their primary learning among all five types of presentation. It is felt that the positive style and redundancy in the guidebook contributed greatly to its success. This is like the organization and redundancy in a Space Shuttle. It's a necessary redundancy if it is to work.

The Trine Guidebook Includes Many Features Not Often Found In Aid System Manuals: The structured documentation techniques, positive multimode presentations, and desktop publishing approach led to a tutorial manual design with features not often found in aid system manuals. Figure 3 shows a typical topic layout. In this paper features of the guidebook design can only be briefly listed:

Overall Features of *A Journeyer's Guide to the Trine System:*

1) Modularity
2) A Multimode Presentation
3) Textual and Visual Redundancy
4) Topics Defined by the Actual Tasks a User Wants To Do
5) Each Topic Is Self Contained
6) Reader Encouraged To Only Look At Relevant Topics
7) Directly Addresses Reader
8) Positive Statements Only
9) Written For a 6th Grade Reading Level
10) Descriptive and Mnemonic Titles
11) Descriptive Headlines
12) Summaries In Each Topic
13) Examples For Each Task
14) Descriptive and Mnemonic Page Numbers

Physical Features:

1) Made With Half Sheet Size Three Ring Binders
2) Binders Have Slip In Covers
3) 6¼" x 8½" Pages
4) Large 5/16" Binder Holes and Sheet Lifters
5) Pages Printed On Colored Copypaper Stock
6) Tabs Printed On Colored 110# Cover Stock With Mylar Reinforcing

Organization Features:

1) Six Distinct Color Coded Parts: 1 Opening, 2 Using the Trine System, 3 Troubleshooting, 4 User Tips, 5 Connecting & Adjusting, 6 Reference & Index
2) An Instant Demonstration On the Very First Page
3) Tabs At Every Section
4) Complete Table of Contents At Its Own Tab
5) The Contents of the Section Listed At Its Beginning
6) The Main Points of the Section At Its Beginning
7) The Contents of Adjacent Sections Listed At the Beginning of Each Section
8) An Expandable User Tips Section For Notes With Helpful Tips Written By Actual Users
9) A Distinctive Red Troubleshooting Section At Its Own Tab
10) A Complete Glossary At Its Own Tab
11) A Complete Index At Its Own Tab

Layout Features:

1) A Basic Layout Repeated For Each Topic
2) Each Topic Has Text Page and a Facing Visual Exhibit Page
3) Headlines 18 pt. Bold Times-Roman Type (72 pt. to an inch)
4) Ruler Lines To Set Off 12 pt. Helvetica Summaries
5) Text 10 pt Helvetica With Bolded Keynames and Menu Items
6) Eye Catching Symbols In the Left Margin Marking Special Paragraphs
7) Exhibit Page Has 14 pt. Caption
8) Realistic Screen Illustrations
9) Realistic Keyboard Illustrations
10) Tabular Instruction Lists

Production Features

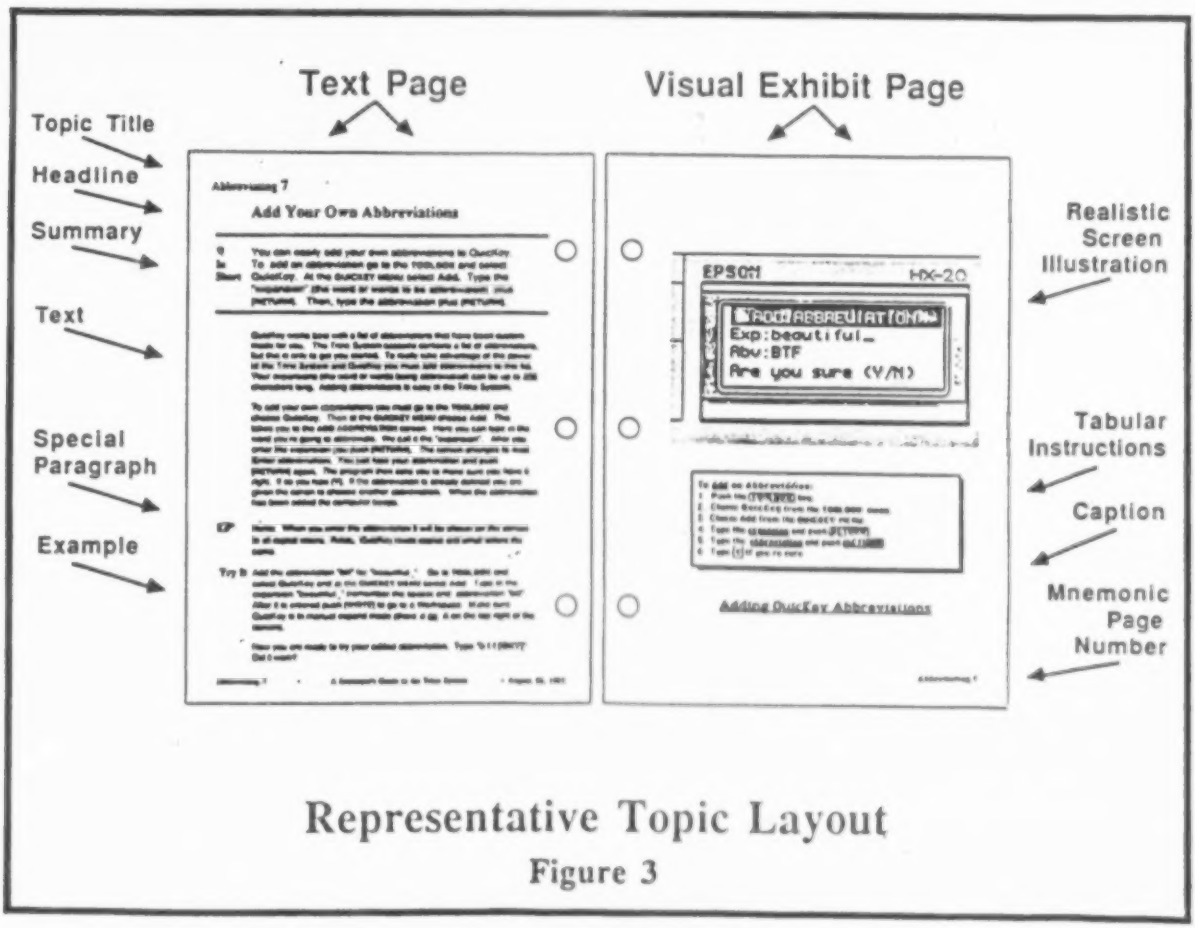
1) Designed In-House using the Apple Macintosh and Macpaint
2) Typeset In-House Using Apple Macintosh. The edition tested was done on 80 dpi Apple Imagewriter and the second edition (Figure 3) was done on 300 dpi Apple LaserWriter.
3) Printed Via Photocopier (Except Tabs Which Were Offset Printed)

Conclusion: This study suggests that tutorial manuals like *A Journeyer's Guide to the Trine System* with the features listed above can allow users of complex computer based aid systems to learn these systems without expert help. This type of manual might allow more users to get the most from their aid systems and might reduce the cost to manufacturers and dealers of personal support.

1. Beta Test Report for DOE Grant 300-83-0267, Technology Compensatory Activities, July 1985, Trace Research and Development Center, University of Wisconsin-Madison.

Acknowledgement: Work was done under contract 300-83-0267 with the Office of Special Education, DOE and under National Institute of Handicapped Research grant G008300045

Address: Trace Research and Development Center, 1500 Highland Avenue, Madison, WI 53705, (608)263-5683



Representative Topic Layout

Figure 3

BEST COPY AVAILABLE

MEMO

To: Barry Romich, Susanne Shealey, Neal Russell

From:: Barry Rodgers

Date: October 29, 1985

Re:: Barry asked for some constructive comments on the new LIght Talker Manual.

Congratulations! I think this is the best manual you've done. It's more attractive, more friendly, better organized, and more functional. The tabs and colored pages really look good. I'm also pleased that you have used some of the techniques and features of the Trine Guidebook, since that was one of the reasons we did it.

First as I'm sure you know, a manual is never really done. As soon as something gets done there are ten things that you can see that you could improve. This is frustrating because changes cost so much they are warranted only to help a manual meet the basic purposes it was designed for. However, since manuals must be maintained or changed anyway throughout the life of the system that they describe due to the need to correct inevitable errors, rewrite sections that confuse the readers, add and change sections as new features are added, etc., you can incorporate general improvements gradually at that time. In any case, this maintenance process must be planned and budgeted for the life of the document.

The only way to really determine if a manual works is to see how well the intended readers have learned from it after using it in ordinary ways. I haven't had time to use the manual with the Light Talker so my comments relate only to the more obvious things. Here are a few thoughts that come to mind as I look through it.

1) I like your consecutive number system because it is friendly and easy for the reader. However, it may get in your way when you do corrections, updates, additions, etc. because if you add or subtract any pages you will have to re-master the page numbers on every page, redo all the tables of contents, and redo the index.

On the other hand, I think page numbers like 1.3 or 4.7 are intimidating and confusing. We compromised in the Trine Guidebook with a **word-number** system. We have gotten good feedback on it. People seem to find a page number like **Starting Out 5** friendly and easy to remember.

2) I like the fact that you generally didn't get more than 3 levels deep in your organization and that you resisted using outline numbering for the various levels. For example,

GETTING STARTED
IMPORTANT INTRODUCTORY COMMENTS
POSITIONAL COORDINATES

However, modern structured documentation suggests that everything the reader needs to know about a topic be contained in that topic. This usually means having a maximum of 2 levels and that both levels be represented on each page so that the reader doesn't have to remember the section title, subsection title, subsubsection title, etc. in order to understand the material on the

page. Most non engineers, i.e. most people have trouble with outlines. They like lists. Decomposing a normal outline that has many levels into a structured outline with only 2 levels is fairly easy but has to be done in the beginning or it is a lot of work. For example, the Getting Started section might look this:

Getting Started

Unpacking the Light Talker..... Getting Started 1
Understanding the Shipping Settings..... Getting Started 2
Identifying Light Talker Positions..... Getting Started 3
Making Yes and No Responses..... Getting Started 4
Turning it On..... Getting Started 5

Adjusting the Viewing Angle..... Getting Started 6
Understanding the Display..... Getting Started 7
Recalling Prestored Sample Sentences..... Getting Started 8
Changing the voice..... Getting Started 9
Spelling Your Message..... Getting Started 10

Storing a Message..... Getting Started 11

3) I think your headlines are better in this manual. Headlines, I've learned, are an art. Plan on having them evolve through the different drafts of a topic. They should identify the topic from the reader's point of view and evoke in the reader's mind the nature of topic. They should be as friendly and informative as possible. For example, here is one of your good headlines: **Recalling Prestored Sample Sentences**. On the other hand, I think the **Positional Coordinates** headline could be improved . For example, it could be **Identifying Light Talker Locations.**

4) Your page design is one of the weakest areas of this manual. The design of the page should make the organization obvious. People see and read the visually clearest material first. That should be your headline and then your subheadline if you have one (ideally not used). For example, on page 4 the note has more visual weight than the headline. On page 6 your screen exhibit has more weight than the headline. With the Mac it is easy to give your headlines more weight. I suggest a warm serif font like the 18 point bold Times used in the Trine Guidebook.

For example: **Recalling Prestored Sample Sentences**

5) A better photocopy machine will make your manual more attractive and friendly. The Trine Guidebook was printed on a photocopy machine. The contrast and solidity of the characters in it are much better than in the Light Talker manual you sent me.

6) The holes for ring binding should be 5/16" rather than the 1/4" you used. We have been told that the ring binder industry is in the process of changing over to all 5/16" holes. The pages are much easier to turn and last much longer.